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Original Articles—

ORIGINAL ARTICLES

STUDIES ON INDIAN CUCURBITACEAE

With Special Remarks on Distribution and Uses of Economic Species

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(Received for publication on 26 March 1945)

(With Plates I-XII and four text-figures)

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INTRODUCTION

INDIAN Cucurbitaceae furnish an interesting histological study owing first to the presence of distinct bicollateral nature of bundles in the stem and to the presence of anomalous anatomical characters in some of the genera, secondly to the special contrivances of depositing calcium carbonate and calcium oxalate, during the process of metabolism, in the shape of cystoliths and crystals respectively in the epidermal cells of the leaves. Morphologically it is interesting for the presence of extrafloral nectaries in the vegetative organs especially on the leaf blade and the petiole and also for the mechanism in the construction of the flower and the tendril which is still a debatable problem. Economically Cucurbitaceae play an important role in the supply of a good many of our common vegetables and also in the supply of a substantial number of indigenous drugs obtainable from genera like *Trichosanthes*, *Lagenaria*, *Luffa*, *Benincasa*, *Momordica*, *Cucumis*, *Citrullus*, *Coccinia* (*Cephalandra*), *Cucurbita*, *Bryonopsis* (*Bryonia*), *Mukia*, etc.

Some of the species of Cucurbitaceae are cultivated and some are found in a wild state, throughout India. In the alpine zones of the Himalayas, above 9,000 ft., cucurbitaceous plants generally cease to exist.

This important family is principally confined to the tropics. In India both the climbing and trailing species are met with in great abundance. The climbing Cucurbits often attain so great a size that they completely cover large trees with luxuriant foliage. This well-known family of which some of the species are very extensively cultivated is still far from being well understood. The structure and habits of these plants are so peculiar that it is difficult to find any parallel with which to compare them and learn by analogy their true relations in the vegetable kingdom. The family thus stands almost alone and its species can scarcely be confused with any other except those of the Passifloraceae.

Deferring to their proper place all remarks on the genera and organs from which characters are drawn, the author may observe here that the discrimination of species is extremely difficult as no reliance can be placed on the form of the leaves as affording specific identifying characters. Almost every variation of form, from simple up to much divided leaves, is found in the same species and even occasionally in the same plant. Nearly all the cucurbits are annuals with climbing succulent stems, furnished with tendrils which are supposed as abortive lateral stipules or metamorphosed branches or, according to modern botanical doctrines, transformed leaves, stipules being considered modified leaves. The flowers are usually unisexual, the male and female generally on the same plant (monoecious) or even springing from the same axil; or rarely they are on different plants (dioecious,

as in *Trichosanthes palmata or T. dioica*, usually the flowers are white, red or yellow. The coloured portion of the flowers is supposed by some botanists to be a petaloid calyx, and the apparent calyx, merely certain external appendages—a view not likely to find many supporters. The stamens in this family are peculiar and present many variations of form. These have sometimes been employed as distinguishing characteristics of the different genera. The fruit like every other part of these singular plants is quite *sui generis* and is in consequence designated by its own name, pepo or peponida, hence Peponiferae—the name given by Bartling and Endlicher to the class. The true pepo as has recently been shown is a tricarpellary fruit but with the carpels inverted, that is with the dorsom of the carpellary leaf in the axis, and the placentiferous margins turned towards the circumference instead of towards the axis as is usual with other fruits. Differences are so great in the construction of this most essential organ that their affinities with other families have still to be determined. In order to facilitate the right understanding of this most difficult and complex family, the following introductory remarks may be useful :

" Calyx 5-toothed, sometimes obsolete. Petals 5 distinct or more or less united, sometimes scarcely indistinguishable from the calyx, strongly marked with reticulating veins, sometimes fringed, stamens 5, distinct or triadelphous, anthers 2-celled (or rarely 1-celled), usually long, sinuous, rarely ovate, ovary adhering to the tube of the calyx, of 2 or 3 carpels. Carpels inverted that is, having the dorsum in the axis and placentiferous margins in the circumference, hence the fruit 2-3 - celled but with 4 or 6 parietal placentas ; ovules solitary or indefinite, imbeded in pulp ; style short ; stigmas 2 or 3, 2-lobed, very thick, velvety or fringed. Fruit fleshy usually a peponida. Seeds many usually ovate or compressed, enveloped in a juicy or dry and membranous arillus ; testa coriaceous, often thick at the margin. Albumen none. Embryo straight ; radicle next the hilum ; cotyledons foliaceous palmatinerved. Stem succulent ; climbing by means of tendrils usually lateral and formed of abortive stipules. Leaves palm-inerved, alternate ; flowers unisexual ".

Geographical distribution

As already stated, the cucurbits are widely distributed throughout the warmer parts of the globe, especially in the tropics. About one hundred genera with about eight hundred species are at present known. Of these, 28 genera comprising about 87 species, occur in the tropical regions of India. About 15 species are cultivated principally for their edible fruits.

The Old World has the greater number of genera but the New World contains a larger number of species. Excluding Cucurbita which is probably not endemic in the Eastern Hemisphere, seven genera are common to the East and the West. This family, though extensively a tropical one and of more frequent occurrence in India than in any other country, has yet a wide distribution over the world, a few being found even as far north as Europe. At the Cape—we learn from Harving's *Genera of South African Plants*—there are species belonging to seven different genera ; one species is found in the Norfolk islands, but plants belonging to this family are generally rare in Australia. In equitorial America and Africa they are of more frequent occurrence, but nowhere so abundant as in India and her islands, extending eastwards to China and Japan. Blume enumerates 40 species found in Java alone, which leads one to the inference that the rest of Asia produces at least three or four times as many. Seringe, however, assigns only 70 to Asia, which single fact shows how little the family is known, since more than half of the whole number are from Java.

In the following pages the author has attempted to bring out a complete list of the species of Cucurbitaceae at present found in India and Burma. The area surveyed includes the whole of India comprising Baluchistan and the borders of Afghanistan as the North-West limit, the Himalayas covering the whole eastern, western and central ranges and also the kingdoms of Nepal and Bhutan, as the northern limit and a part of the plateau of Tibet. In the east the area covers the whole of the Indo-Burma frontier penetrating at some places into Yunan, the frontier of China and Burma. In the south, the area covers Ceylon in the Indian ocean and the Andaman and Nicober islands and also the Cocos group in the Bay of Bengal. The Maldives and Laccadives whose flora are akin to the vegetation of Peninsular India have also been embraced. The maps attached herewith will clearly show the area surveyed and the wide range of distribution of wild economic species. The

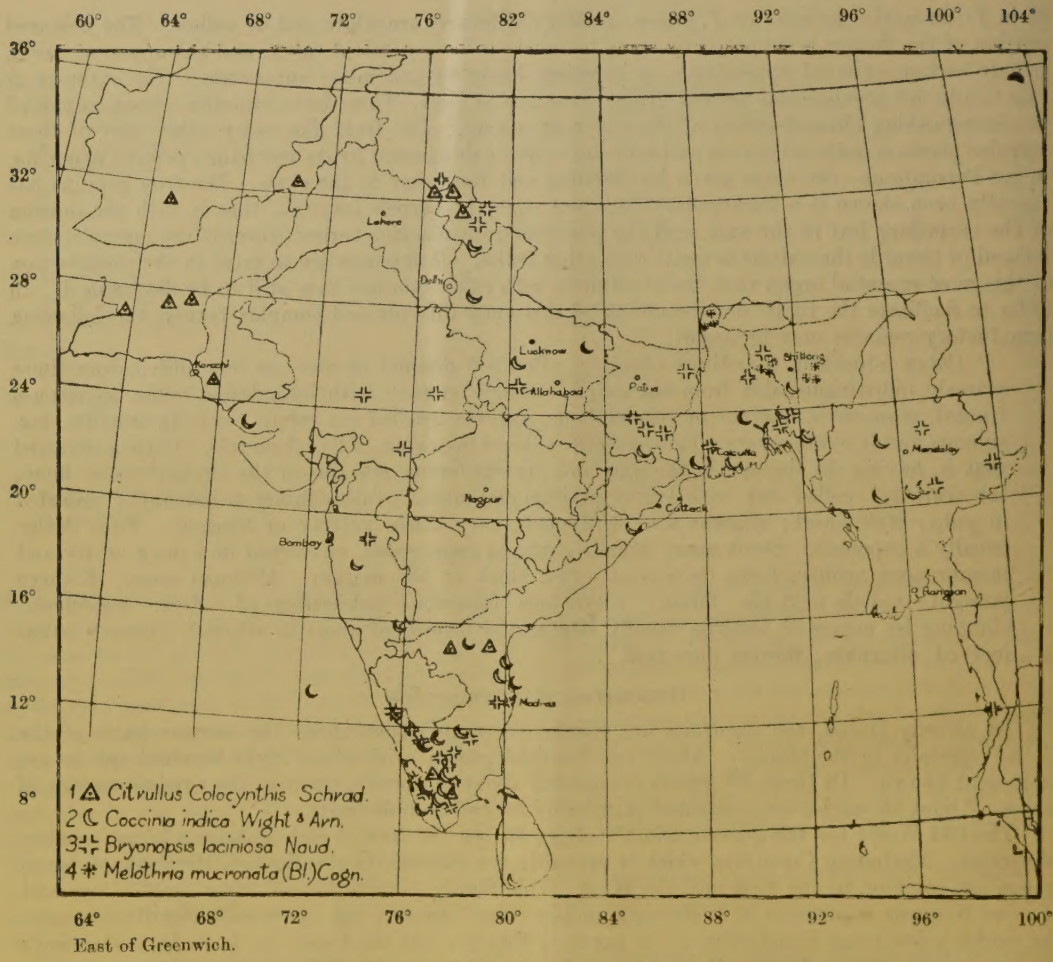

FIG. 1. Distribution of economic cucurbits.

spots of occurrence of these species have been plotted with reference to actual places from where specimens have been collected. The signals indicated in the maps also give in addition an approximate idea of the areas round about which the species in question do occur or are expected to occur. Hooker in his *Flora of British India* has enumerated about 70 species under 29 genera. But a few species have been included along with other new records thus totalling the number of species to 87. The genera *Mukia* and *Zehneria* of *Hooker's Flora of British India* have been reduced to *Melothria*. For the sake of convenience, the measurements of micro structures in the following species have been given in metric system: *Trichosanthes cuspidata* Lam., *T. brevibracteata* Kundu, *T. Perrotletiana* Cogn., *T. villosula* Blume, *T. ovata* Cogn., *T. tricuspidata* Lour., *T. lepiniana* Cogn., *T. anaimalaiensis* Bedd., *T. majuscula* Kundu, *T. khasiana* Kundu, and *Momordica macrophylla* Gage. The genus *Cyclanthera* has been added with one species *Cyclanthera pedata* Schrad.—an American plant which seems to be introduced and naturalized in the North-Western border of the Himalayas. Of the 28 genera occurring in India, 37 species have been recorded as endemic and the rest are non-endemic. Some of these non-endemic species may be traced to have travelled from Europe, a good many from Africa and quite a lot from Malaysia. Table I will explain the comparative relationships of the Indian species with those of the world.

TABLE I

Numerical comparison of the Indian species with those of the world

Genera	Total number of species in the world	Number of endemic species	Number of non-endemic species	Total number of species found in India	Percentage of Indian species in comparison with those of the world
Hodgsonia	1	..	1	1	100
Trichosanthes	44	18	5	23	52·2
Gymnopetalum	6	2	2	3	50
Biswarea	1	1	..	1	100
Lagenaria	1	..	1	1	100
Herpetospermum	1	1	..	1	100
Luffa	6	1	4	5	83·3
Benincasa	1	..	1	1	100
Momordica	25	..	6	7	38
Cucumis	26	..	4	4	15·3
Citrullus	3	..	2	2	66·6
Coccinia	13	..	1	1	7·7
Cucurbita	10	..	3	3	30
Thaldiantha	4	1	1	2	50
Edgaria	1	1	..	1	100
Bryonopsis	2	..	1	1	50
Melothria	54	3	6	11	20·3
Kedrostis	11	..	1	1	9·1
Cerasiocarpum	1	..	1	1	100
Corallocarpus	15	1	2	3	20
Blastania	2	1	1	2	100
Dicaelospermum	1	1	..	1	100
Cyclanthera	39	..	1	1	2·6
Actinostema	4	1	..	1	25
Zanonia	2	..	1	1	50
Gomphogyne	2	2	..	2	100
Gymnostema	3	1	1	2	66·6
Alsomitra	11	2	1	3	27·3
TOTAL	290	37	47	86	29·6

NOMENCLATURE

In the binomial nomenclature of the species, the older obsolete names as given in the *Flora of British India* have been discarded in the present paper. Attempts have been made to ascertain the correct name of a species. According to *International Rules of Botanical Nomenclature*, the name given to a species by the author of its first recorded authentic description has priority over the name or names which subsequently may have been given to it by other authorities, unless the name has to be changed owing to transference of the species to another genus. It sometimes happens that the same names have been given to different species by different authors. Accuracy in describing a species however, could not be often maintained by the authors while describing the same species. Where this has happened according to the *International Rules* the original specific name is retained and two authorities have been given for the change. The author of the original name is first shown in the brackets followed by the author of the new combination. According to the present convention of *International Rules of Botanical Nomenclature* which is however not obligatory, the use of

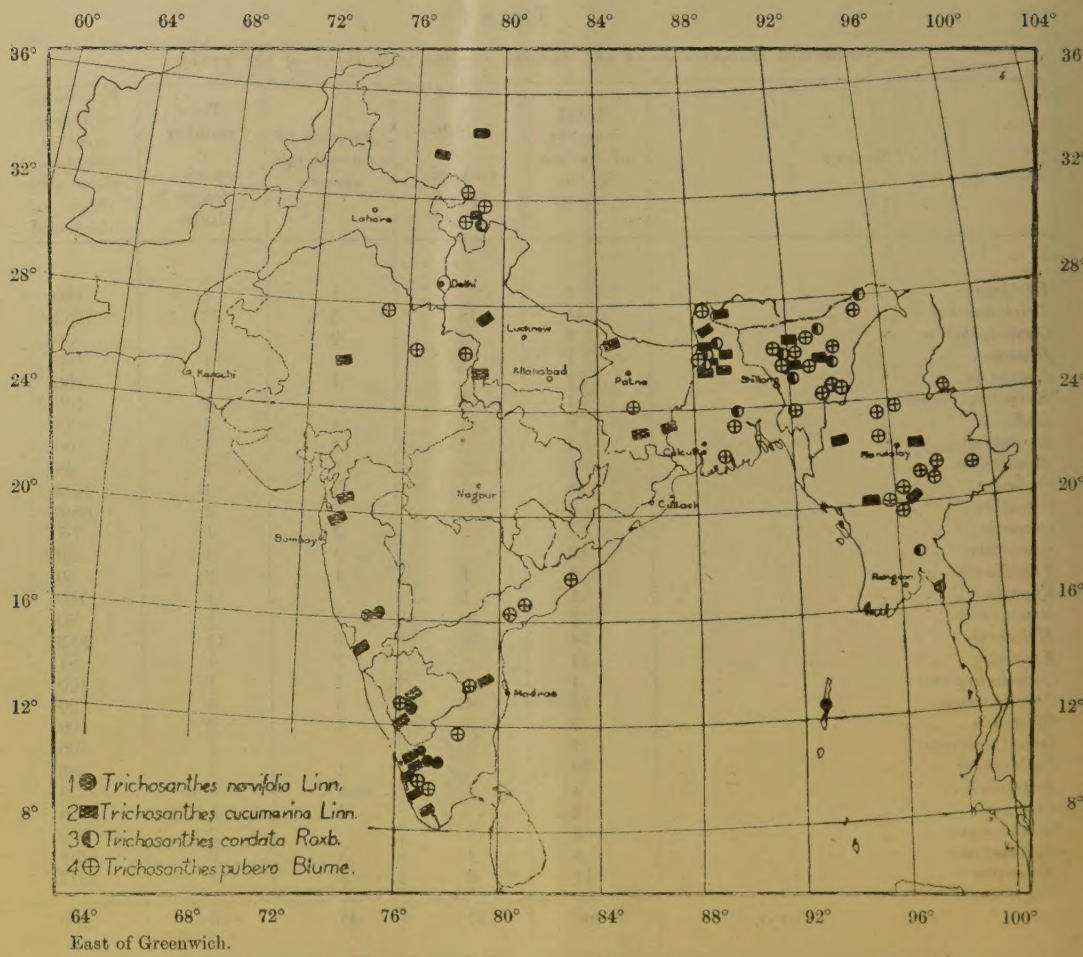

FIG. 2. Distribution of economic cucurbits.

capital letter for the specific name has been abolished except in the cases where the specific name has at sometime been used as a generic name, where the specific name is a genetive singular or an adjectival form of some one's name. This recommendation is not however followed by many applied botanists, who irrespective of their derivation write specific name with a small initial letter. In checking these names in addition to consultation of original papers the following books have often been referred to :

(1) *Index Kewensis*, (2) *Index Londinensis*, (3) *Gamble's Flora of Madras*, (4) Prain's *Bengal Plants*, (5) *Kew Bulletins*, *etc.*

The following names have been checked and changed :—

syn. *Gymnopetalum integrifolium* Kurz. . . .	*Trichosanthes integrifolia* Kurz.
syn. *Trichosanthes palmata* Roxb.	*Trichosanthes bracteata* Voight.
syn. *Trichosanthes multiloba* C.B. Clarke . . .	*Trichosanthes Wallichiana* Wight.
syn. *Trichosanthes lobata* Roxb.	*Trichosanthes cucumerina* Linn.
syn. *Trichosanthes reniformis* Miq.	(reduced to) *Trichosanthes cucumerina* Linn.

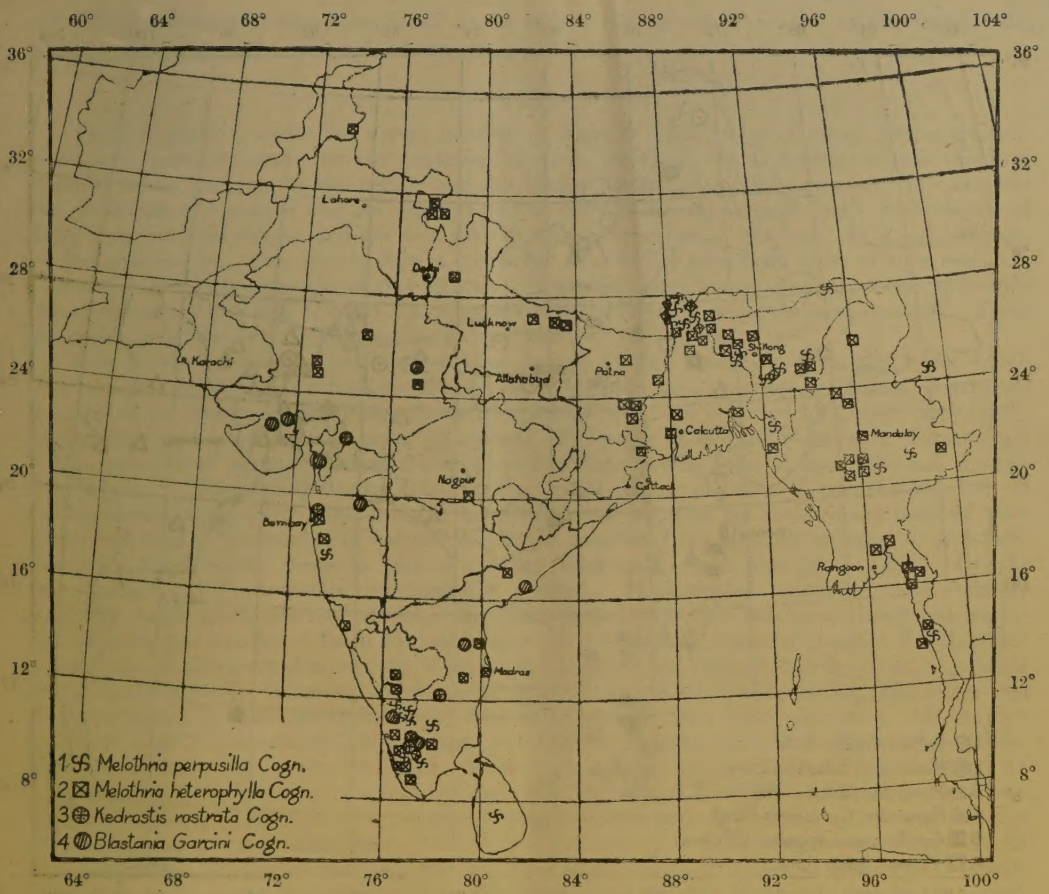

FIG. 3. Distribution of economic cucurbits.

syn. *Cephalendra indica* Maud.	*Coccinia indica* Wight.
syn. *Bryonia laciniosa* Linn	*Bryonopsis laciniosa* Naud.
syn. *Mukia scabrella* Arn.	(reduced to) *Melothria maderaspatana* (*L.*) Cogn.
syn. *Mukia leiosperma* Thw.	(reduced to) *Melothria leiosperma* (W. & A.) Cogn.
syn. *Zehneria Baueriana* Endl.	(reduced to) *Melothria muronata* (Bl.) Cogn.
syn. *Zehneria Hookeriana* Arn.	(reduced to) *Melothria perpusilla* Cogn.
syn. *Zehneria umbellata* Thw.	(reduced to) *Melothria heterophylla* Cogn.
syn. *Melothria odorata* Hk. f. & T.	*Melothria leucocarpa* Cogn.
syn. *Rhynchocapara foetida* Schrad.	(reduced to) *Kedrostis rostrata* (Rottl.) Cogn.
syn. *Thladiantha dubia* Bunge.	*Thladiantha calcarata* C.B.Clarke
syn. *Ctenolepis Garcini* Naud.	(reduced to) *Blastania Garcini* (L.) Cogn.
syn. *Corallocarpus conocarpa* Hook.	*Corallocarpus conocarpus* Benth. Hook.
syn. *Ctenolepis ceraciformis* Naud.	(reduced to) *Blastania fimbristipula* Hotschy.
syn. *Warea tonglensis* Naud.	(reduced to) *Biswarea tonglensis* (C.B.Clarke)

The following species have been added :

Trichosanthes tricuspidata Lour ; *T. Lepiniana* Cogn ; *T. Thwaitesii* Cogn., *T. anaimlaiensis* Bedd., *T. ovata* Cogn., *T. cuspidata* Lam., *T. Perrottetiana* Cogn., *T. villosula* Blume., *T. brevibracteata* Kundu., *T. majuscula* Kundu, *T. pachyrrhachis* Kundu, *T. khasiana* Kundu, *Momordica macrophylla* Gage., *Cyclanthera pedata* Schrad., *Alsomitra pubigera* Prain,

FIG. 4. Distribution of economic cucurbits.

INTERNAL MORPHOLOGY

In almost all the species of Cucurbitaceae the vascular bundles are bicollateral in structure. These bundles are always separated from one another by broad stripes of ground tissue. In the herbaceous species a sclerenchymatous ring which is usually continuous is developed in the cortex; in these forms the vascular bundles are also as a rule arranged in two rings. The sieve tube occurs in the stem outside the florovascular system. A definite type of stoma does not appear in the order. The hair covering consists of (a) simple unicellular or uniseriate structures, the base of which is sometimes surrounded by subsidary cells or (b) spiny trichomes or (c) shortly stalked glandular structures composed of few cells. A very common feature of these order is the occurrence of

cystolith like structures which are found in the cells of the hairs and in the neighbouring cells, whether belonging to the epidermis or the mesophyll.

Leaf

The leaf anatomy opens out a very interesting chapter. The leaves of many species are provided with peculiar glands for the exudation of waste products. In *Lagenaria vulgaris* they are confined to the junction of the petiole and the blade and are bilaterally arranged. In *Cucurbita* the glands are club-shaped and are confined to the lower surface of the leaf, while in *Coccinia* and *Luffa* they are oval shaped and are met with on the undersurface of the leaf. In a right-angular longitudinal section, these glands show a somewhat thickwalled superficial layer of cells enclosing a mass of reserve cells containing sugary solution. A mass of tissue, known as supply-tissue, surrounds the superficial layer of cells in which a number of tracheidal ends are projected symmetrically. These tracheides carry the exuding solution from down below to the leaf end.

Most of the species of Cucurbitaceae have devices for the exudation of surplus water which they absorb from the soil. Hydathodes and water-stomata are, therefore, of general occurrence in many of the species. Sieve-like hydathodal systems have been observed by Chakravarty [1937] in *Cucurbita pepo* provided with pores all around. The genus *Momordica* is however characterized by the presence of calcium carbonate and calcium oxalate in the form of cysloliths and crystals respectively. Anatomical studies [Chakravarty, 1937] of the mid-ribs of cucurbitaceae reveal an interesting phylogenetic relationship of the different species from the evolutionary point of view if the reduction of the number of vascular bundles is considered the principle critarion of evolution. The genus *Trichosanthes* seems to have a striking relationship with the genus *Luffa*. Of the two species of *Trichosanthes* anatomically studied, *Trichosanthes anguina* more closely resembles *Luffa* which has four vascular bundles arranged crosswise, the lowest being the largest and topmost the smallest. From the standpoint of reduction of vascular bundles *Trichosanthes dioica* seems to have been derived from *Trichosanthes anguina*, the topmost bundle of the cross being absent in the former. Moreover, *Trichosanthes anguina* can still be found growing wild, while *Trichosanthes dioica* is never found in a wild state and has undergone wide cultivation. Of the two species of *Luffa* (*L. acutangula and L. aegyptiaca*), *Luffa acutangula* seems to be the more primitive. Here the topmost bundle may be taken to be a compound one made up of two bundles. In *Luffa aegyptiaca* (*L. cylindrica*) the topmost bundle is a perfect single whole and there seems to be a tendency of further reduction of the number of the two intermediate bundles. These two bundles are found joined in the proximal part of the mid-rib and may in course of time be fused and reduced to a single one. *Momordica charantia* seems to have been derived from *Momordica cochinchinensis*. The latter species contains five vascular bundles at the mid-ribs as against only four in the former at the base of the mid-rib coalascing eventually into a single bundle.

Cucumis sativa seems to be more primitive than *Cucumis melo* ; of the four vascular bundles of the latter species, three at the top are on the verge of extinction. Loureiro [1790] in his *Flora Cochinchinensis* named *Benincasa hispida* Cogn. *(*B. cerifera* Savi) as *Cucurbita pepo* Lour., while Blume [1826] in his *Bidragen tot de van Nederlandsch-indie* designated it as *Cucurbita ferinosa* Blume. Wallich however in his *Catalogue* No. 6723 renamed it as *Cucurbita hispida* Wall. which from its external appearance seems to have much resemblance with *Cucurbita pepo*. It is remarkable that authors like Loureiro, Blume and Wallich placed *Benincasa hispida* as a species of *Cucurbita*, but the number of vascular bundles (seven) and their elliptical arrangement in *Cucurbita pepo* differ greatly from those of *Benincasa hispida* which has four vascular bundles lying vertically in a straight line. This difference may be explained by the fact that each pair of bundles horizontally placed in the mid-rib of *Cucurbita pepo*, except the basal one which is the largest and fixed, approaches

*Characters common in *Benincasa* and *Cucurbita* are : Large climbing herb, soft hairy tendrils 2-4 fid in *Cucurbita*, but 2-fid in *Benincasa*. Leaves cordate 5-angular or lobed ; petioles without glands. Flowers large yellow monoccious, all solitary without bracts. Male, calyx tube campanulate, lobes 5-linear or foliaceous ; corolla campanulate 5-lobed ; stamens 3 inserted in the calyx tube. Female, calyx and corolla as in the male ; ovary oblong ; ovules many horizontal ; placentas 3, fruits fleshy, large, indehiscent ; seeds compressed.

one another and finally fuses to form a single bundle with the result that there are three bundles in a straight line just above the basal one which corresponds with the arrangement in *Benincasa hispida*. *Benincasa* may therefore be regarded as an advanced form of *Cucurbita*.

The petiole of Cucurbitaceae contains isolated vascular bundles. These bundles are arranged in the form of a horseshoe or a circle in transverse section, those of the large size having bicollateral structure. The number of bundles varies both in the initial and characteristic regions.

The stem

The stem is characterized by the presence of bicollateral vascular bundles in two rings and a continuous strengthening ring in the cortex. The xylem contains vessels with very wide lumina and simple perforations. The phloem groups are composed of sieve tubes with wide lumina. The internal soft bast sometimes shows secondary thickening. The outer cortex is built up of selerenchymatous ring consisting of prosenchymatous elements. This ring of selerenchyma which is usually continuous and often has an undulating course in transverse sections of the stem appears to be present in all the herbaceous members of the order which do not exhibit any considerable amount of growth in thickness. In those species, on the otherhand, which form woody stem, the selerenchymatous ring is wanting, since in this case the mechanical support is afforded by the ring of wood. The formation of cork is rare.

The root

Some members of the order have roots with anomalous structure : for instance, *Cucurbita* is distinguished by the occurrence of islands of soft bast situated in the wood and connected with the interxylary phloem of the axis. Cucurbitaceae mostly possesses a pith containing intraxylary groups of soft bast which subsequently may become converted into inversely oriented vascular-bundles.

Cytology

The cytology of the species belonging to Cucurbitaceae seems not to have been sufficiently studied. Kirkwood [1907] and Kratzer [1918] who have investigated the development of embryosac in a number of species have arrived at the conclusion that the development of the embryosac is of the normal type. Banerjee and Das [1936] working on *Trichosanthes dioica* have also confirmed the findings of Kirwood and Kratzer. The magaspores differentiate out in the third layer of mother cells or are hypodermal in origin. Kirkwood [1907] worked out the process of pollen formation in *Micrampelis alba* and found that the process of chromosome conjugation was of the parasynaptic type. Strasburger [1910] worked on *Bryonia alba* with an idea to determine the sexual mechanism of the plant. Boenicke [1911] studied the heterotypic cell divisions in *Bryonia dioica*. Later on *Bryonia dioica* was re-investigated cytologically by Meurman [1925] and Lindsay [1936]. Kozhuchow's [1925] investigations were mostly confined to somatic cells of a number of Cucurbitaceous plants. He also determined the chromosome numbers of the species he studied. Castetter [1926] described the meiosis in *Cucurbita pepo*. He proved that cytokinesis takes place by furrowing in this plant. Heimlich [1927] worked out the meiosis in *Cucumis sativus*. Passmore [1930] has given a comprehensive account of the process of pollen formation in *Cucurbita pepo*, *Cucurbita maxima*, *Citrullus vulgaris*, *Luffa aegyptiaca*, *Cucumis melo* and *Cucumis sativus*. He found that the process of chromosome conjugation is of the parasynaptic type in the family Cucurbitaceae. Asana and Sutaria [1932] have given a general account of the pollen formation in *Luffa aegyptiaca* and also determined the chromosome number of some of species. Sinoto [1928] has observed the presence of heteromorphic pair of chromosomes in *Trichosanthes japonica*. But Lindsay [1936] and others have failed to find

any heterochromosome in *Bryonia dioica*. Chromosome numbers in a few species of Cucurbitaceæ are shown in Table II.

TABLE II

Chromosome numbers in a few species of Cucurbitaceæ

Name of species	Chromosome number (n)	Reported by
Melothria punctata Cogn.	12	McKay
Melothria abyssinica	12	McKay
Momordica balsamina Linn.	11	McKay
Luffa ægyptiaca Mill.	13	McKay and Passmore
Ecballium Elaterium A. Rich.	12	McKay
Citrullus colocynalhis Schrad	11	Kozhukhow, Passmore, Whitaker
Cucumis myriocarpus Naud.	12	McKay
Cucumis Melo Linn.	12	Passmore, Kozhukhow and McKay
Benincasa hispida Cogn.	12	McKay
Cucurbita maxima Duchesne	20	Castetter and Passmore
Cucurbita Pepo Linn.	20	Lundegarth
Cyclanthera pedata Schrad.	16	McKay
Trichosanthesdioica Roxb.	11	Banerji and Das
Trichosanthes Anguina Linn.	11	Banerji and Das

AFFINITIES AND SYSTEMATIC POSITION

There is a great deal of controversy as to the systematic position of this family. Hitherto, Cucurbitacea has been by an universal consent arranged among families with one-celled ovary and parietal placenta, but it is difficult to agree with it, if the explanation about the formation of pepo as discussed before be found correct, since in the fruit, we have a peculiarity of structure by which the family is separated from every other known order of the vegetable kingdom. Lindley (1836) places it in his Epigynous group amongst a suit of orders possessing axile placentation, but distinguished the Cucurbitaceae by possession sinuous stamens, unisexual flowers and exalbuminous seeds. Endlicher (ex Wight, 1850) places it between Begoniaceæ and Passifloraceæ, the affinities of which have not been clearly understood. The very intimate union of the calyx and corolla which led Jussieu (1789) to view the flowers as apetalous and to range the order under his class Apetalæ, is a point of structure which cannot be overlooked in determining the affinities. Wight [1850] thinks that though Jussieu's view on this point is essentially incorrect yet it suggests a relationship with Euphorbiaceæ in some striking points. As a family, Cucurbitaceæ is distinguished from all others by its stamens but more especially the anthers, the cells of which in most cases are very long, winding upwards and downwards on the external surface of the connective. The structure of the anther, combined with the construction of the ovary and fruit, the habit of the plants and lateral tendrills, widely separates this family from any other families in the vegetable kingdom. Various attempts have, however, been made to find associates near which it may be placed in the system of the plants. Of the families thus selected as relations, some have superior and some inferior fruits and some albuminous and some exalbuminous seeds. The grouping of Cucurbitaceæ in Epigynose, as done by Lindley, is untenable because the other relative groups are distinguished by one-seeded ovary; but as a set-off against this disadvantage, he constructs the alliance of these groups having parietal placenta.

The botanists of the old school like Robert Brown, de Candolle and Naudin placed Cucurbitaceæ with Passifloraceæ among perigynous polypetalous families and this view was supported by Benthum and Hooker. Eichler [1875-78] placed it as an appendage to his series Campanulineæ next to the family Campanulaceæ. In support he advanced arguments that the family possesses typically epigynous and pentamerous flowers and that it has the tendency of union of stamens and that the calyx

which though narrow is often foliaceous in nature. Engler [1916, 1936] while supporting the view advocated by Eichler, has placed the family by itself in a series Cucurbitales next to the series Campanulales. Fairly sounder reasons may, however, be put forward in support of the older view. The structure of the ovule with a large persistent nucellus, and extensive tapetal tissue and two distinct integuments, is a difficult obstacle to overcome and gives it a position amongst the typical sympetalous families, but it seems to find a suitable association with Passifloraceæ and the allied families. In these families there is a tendency of inferior ovary and union of the members of the corolla. Rendle [1938] accepted the position suggested by Hallier [1905] and places Cucurbitaceæ with Begoniaceæ and next to Passifloraceæ. Vuillemin [1923] has, however, opined that Cucurbitaceæ must be relegated to the apetalous group of orders and hence he has classed them with Balanophoraceæ, Rafflesiaceæ, Datiscaceæ, Nepanthaceæ and Aristolochiaceæ. He considers them as apetalous and thinks the corolla is nothing but the inner whorl of the calyx.

The writer is inclined towards the older view of Robert Brown, de Candolle and others as supported by Bentham and Hooker and he is of opinion that apart from other considerations, the evolution of unisexuality from hermaphrodity leads Cucurbitaceæ to a place between Passifloraceæ in which the bisexuality of the reproductive mechanism tends towards the unisexuality and *Begoniaceæ* in which the unisexuality is a dominant factor. The remnants of hermaphrodity with rudimentary stamens in female flowers and rudimentary ovary in the male are still present in a number of genera like *Citrullus*, *Kedrostis*, *Corallocarpus*, *Zanonia*, *Bryonopsis*, *Luffa*, *Momordica*, *Trishosanthes*, *Coccinia*, etc.

Medicinal properties

Various important medicinal properties are attributed to different members of this family. Some are bitter and some are endowed with aperient properties of remarkable potency.

Active principle, however, varies with different plants and even with their different parts. It is mild in the root of some and the leaves of the young shoots of others but is greatest in the pulp surrounding the seed. The seed however is free in this respect. There is a reason to believe that some at least, if not all the edible varieties, owe their freedom from this property to cultivation, as some of them in the wild state are found to possess it in great intensity. The *Lagenaria vulgaris* or bottle gourd may be cited as an example. It has been recorded that some sailors were poisoned by drinking beer that had been standing in a flask made of one of these gourds. Royle (ex Wight, 1850) also mentions a somewhat similar case in which symptoms of cholera were induced by eating the bitter pulp. These poisonous properties are, however, attributed to the bitter or wild variety of *Lagenaria vulgaris*. The cultivated gourd is quite a wholesome article of food with absolutely no bitter principle in it. The fruits of many of the species of *Cucumis*, to which melon and cucumber belong, are powerfully cathartic; of these *C. Hardwickii* and *C. pseudocolocynthes* are worthy of notice. Even the cucumber, especially the less cultivated varieties in this country, is sometimes known to prove strongly aperient in susceptible constitutions. *Citrallus colocynthes* which yield colocynth is one of the most valuable medicinal plants.

The fruits of some species of *Luffa* are violently cathartic such as *L. echinata* of Roxburgh, while those of *L. acutangula* are a wholesome pot herb. Some of the species of Bryonia, especially *B. alba* and *B. dioica*, have the cathartic properties of the family. Curiously enough, the juice of the root is strongly cathartic and is often employed as such while the young fruits are so free from the property that they are used as a pot herb and greatly resemble asparagus in flavour. The purgative properties of the root have long been known as being equal in power even when dried and powdered to jalap and when fresh much more so. But of all those yet mentioned none approach the *Elaterium* in the concentrated virulence of this quality; a few grains of the pulp are known to bring about symptoms of poisoning immediately.

Such being the predominating quality of the family, it is wise to be cautious in the use of even the best known. Many however are in use as pot herbs. Among these may be mentioned the red gourd *Cucurbita maxima* (*C. hispida* Anist.), the boiled pulp of which somewhat resembles in taste a fine tender carrot. The water melon *Citrullus vulgaris* is so highly esteemed because of the cool refreshing juice of its large fruit. The white gourd (*Benincasa hispida*) is sometimes presented at marriage

feasts as a token of good luck to the wedded pair. The vegetable marrow (*Cucumis ovifera*) is one of the finest culinary vegetables.

All the numerous cultivated varieties of melons and cucumbers are known to be wholesome. Some of the Indian species of *Momordica* seem equally safe. The fruits of several species of *Trichosanthes*, especially those of *T. anguina* and *T. dioica*, are in daily use, but those of *T. palmata* are considered poisonous. *Coccinia indica* (*Momordica monadelpha* Roxb. or *Cephalandra indica* Naud.) is a common vegetable eaten by the poorer classes and its ripe fruits seem to afford a favourite repast to many birds. Notwithstanding the draw-backs mentioned above, this is certainly a most useful family of plants owing to the great size of the fruits and large quantity of nutritious matter available in the edible varieties which, on that account, are largely cultivated in every part of India. The other varieties, although unfit for human consumption as such, are sources of many useful drugs and medicines. Nevertheless, sufficient caution must always be exercised in their use to guard against the evil effects which may ensue.

DESCRIPTION

Cucurbitaceæ Juss

Cucurbitaceæ Juss. Genera, p. 393 ; Ser. in Mem. Soc. phys. Geneve. **3,** part 1, p. 1 and in DC. Prodr. **3,** p. 292 ; Spach. Veg. phan. **6,** p. 183 ; Schrad. Reliq. in Linnæa, **12,** p. 401 ; Aruin. Hook. Jour. of Bot. **3,** p. 271 ; Wight in Ann. and Mag. of Nat. Hist. **8,** p. 260 ; Lindl. Veg. Kingd. **3,** p, 311 ; Naud. in Ann. Sc. nat., Ser. **4,** p. **16,** p. 45, Ser. **5,** p. **5,** p. 26 ; Harv. and Sond. Fl. Cap., **2,** p. 482 ; Benth. & Hook. Gen. Plant. **1,** p. 816 ; Hook. f. in Oliv. Fl. trop. Afr. **2,** p. 521 ; Cogn. in Mart. Fl. Brass., fasc. **78,** p. 1 ; Clarke in Hook. Fl. Brit. Ind., **2,** p. 604.

General character

Scandent or prostrate herbs or shrubs with watery juice, often scabrid ; tendrils mostly present, solitary, lateral, spirally coiled, simple or divided. Leaves alternate, petioled, frequently cordate, simple lobed or pedately divided. Flowers unisexual monœcious or dioecious very rarely hermaphrodite, actinomorphic, yellow or white ; inflorescence, racemed or solitary, less commonly panicled. *Male flower :* calyx tubular, lobes imbricate or open ; limb rotate campanulate or tubular ; sepals 5 (rarely 3) ; corolla polypetalous or gamopetalous lobes imbricate or induplicate-valvate, *Petals 5* inserted at the mouth of about the middle or at the base of calyx tube, usually 3 (sometimes 5 or 2). Stamens free or variously united mostly 3 rarely 1-5. One anther always 1-celled, the others 2-celled, cells often straight or curved, flexuous or conduplicate, connective sometimes crested or produced beyond. Staminodes usually not present. *Female flower :* Calyx and Coralla as in the male. Ovary inferior (in *Actinostemma* $\frac{1}{2}$ inferior) or very rarely free, unicarpellary but falsely tricarpellary (due to projection of the parietal placenta towards the middle). Placentas often 3, parietal but often meeting in the middle. Style with 3 stigmas, more rarely styles 2-3-4. Ovules many arranged towards the ovarian cells, horizontal, rarely pendulous, sometimes few and pendulous near the top of the ovary (in *Dicœlospermum* 3, erect from the base of the ovary). Fruit generally a berry or fleshy pepo, indehiscent or dehiscent by valves or by a stopple often 1-celled, the seeds being often packed with pulp or fibre. Seeds usually many often compressed, without endosperm, horizontal, pendulous (or in *Dicaelospermum* erect) frequently corrugated or subspinose on the margins. On germination, cotyledons appear above ground as the first green leaves of the plants. In *Cucurbita* the escape of the cotyledon from the seeds is helped by development of a peg upon the lower side of the hypocotyl by which the lower half of the testa is pressed to the ground, while the upper half is raised by the growth of the plumule.

Diagnostic characters

Tendril climbers. Leaves simple, alternate, palmately lobed. Flowers actinomorphic, unisexual monœcious or dioecious. Sepals 5, plysepalous, petals 5, gamopetalous. Stamens 3-5 united in pairs, odd one being free. Anthers free or syngenesious. Ovary inferior, trilocular with parietal placentation. Fruit a pepo or a gourd.

Key to the tribe

A. Ovules horizontal (or pendulous). Female flowers usually solitary, never panicled. Leaves not divided into distinct leaflets (except rarely in *Thladiantha*) . . . . . Cucumerineæ
AA. Ovules and seeds erect . . . . . Orthospermeæ
AAA. Ovules pendulous. Flowers small, the females in panicles and many flowered racemes. Stamens 5 each with a single small straight anther. Zanonieæ

Key to genera

1. Tribe—Cucumerineae.

A. Ovules horizontal or rarely pendulous; female flowers usually solitary, never panicled; leaves never divided into distinct leaflets
B. Anther cells flexuous or conduplicate
C. Corolla 5-partite to the base, 5-petalous
D. Petals fimbriate at their margins
E. Ovules 12, perfect, seeds usually 6, each with an abortive seed attached to its side; calyx tube 3-4 in. long . . . 1. *Hodgsonia*
EE. Ovules and seeds very numerous; calyx tube less than 3 in. long . . . . . 2. *Trichosanthes*
DD. Petals entire
E. Calyx tube of the male flower elongate; stamens inserted within and included in the calyx tube or nearly so
F. Seeds many horizontal; tendrils rarely divided . . 3. *Gymnopetalum*
FF. Seeds many horizontal. Tendrils 2-3 fid; petiole without gland . . . . . 4. *Biswarea*
FFF. Seeds many. Tendrils divided; stigma two lobed; petiole with two glands at apex . . . . . 5. *Lagenaria*
FFFF. Seeds 12-18 pendulous . . . . . 6. *Herpetospermum*
EE. Calyx tube of the male flowers short
F. Stamens inserted at the mouth of the calyx; filaments exerted anthers free
G. Fruit dry endocarp fibrous, opening by a stopple; male flowers partly in raceme . . . . . 7. *Luffa*
GG. Fruit soft, endocarp fleshy, indehiscent; male and female flowers alike, solitary . . . . . 8. *Benincasa*
FF. Stamens inserted below the mouth of the calyx tube; anthers more or less cohering
G. Calyx with 2-3 scales at its base; male flowers with usually a large enveloping bract; tendrils simple; leaves with peculiar cystoliths in the undersurface . . . . 9. *Momordica*
GG. Calyx without scales at the base; male flower with two enveloping bract
H. Connective produced beyond the anther cells; tendrils simple . . . . . 10. *Cucumis*
HH. Connective not produced; tendrils 2-3 fid . . 11 *Citrullus*
CC. Corolla campanulate, not divided more than half way down
D. Flowers white; tendrils simple . . . . . 12. *Coccinia*
DD. Flowers yellow; tendrils divided . . . . . 13. *Cucurbita*
BB. Anther cells straight (or in *Bryonia* slightly curved)
C. Flowers large deep yellow, male almost racemose
D. Calyx tube short; seeds innumerable . . . . . 14. *Thladiantha*
DD. Calyx tube elongate; seeds 3-9 . . . . . 15. *Edgaria*
CC. Flowers not large, yellow, male racemose or pedicles not stout
D. Male and female pedicle alike one flowered, clustered; tendrils bifid . . . . . 16. *Bryonopsis*
DD. Male flowers cymose or subumbellate or racemed
E. Bracts non-ciliated if any
F. Fruit not circumcise
G. Fruit on a carpellary peduncle; connective produced . 17. *Melothria*
GG. Fruit sessile and beaked . . . . . 18. *Kedrostis*
GGG. Fruit subsessile indehiscent . . . . . 19. *Cerasiocarpum*
FF. Fruit circumcise, near the base . . . . . 20. *Corallocarpus*
EE. Ciliate bracts, resembling stipules at the base of the petiole . 21. *Blastania*

II. Tribe—Orthospermea

AA. Ovules erect or ascending
B. Stamens 3, free, inserted on the calyx tube . . . . . 22. *Dicaelospermum*
BB. Stamens united in a central column, filaments short . . . 23. *Cyclanthera*

III. Tribe—Zanonieae

AAA. Ovules pendulous. Flowers small, the females in panicles or many flowered racemes. Stamens 5, free, each with single small straight anther
B. Leaves not divided into separate leaflets
C. Fruit small circumcise ; leaves serrate . . . . . 24. *Actinostemma*
CC. Fruit long clavate ; leaves subentire . . . . . 25. *Zanonia*
BB. Leaves pedately divided into 3-5 leaflets
C. Fruit trigonous obovoid ; leaflets serrate. Tendrils bifid . . 26. *Gomphogyne*
CC. Fruit pea-like ; leaflets serrate ; tendrils simple . . . . 27. *Gynostemma*
CCC. Fruit elongate clavate ; leaflets entire ; tendrils simple or 2-fid . 28. *Alsomitra*

1. *Hodgsonia*

Hodgsonia Hook. f. & Thoms. in Proc. Linn. Soc. (1853) 257 ; Hook. f. Illustr. of Him. Pl., tab. 1-3 ; Naud. in Fl. des Serres, 12, p. 153 ; Benth. et Hook. Gen., **1,** p. 821 ; Clarke in Hook. f. Fl. Brit. Ind. **2,** p. 606.

A large climbing shrub. Leaves coriaceous 3-5 lobed ; tendrils often 2-3 fid. Flowers large dicœcious. Inflorescence - staminate flowers, racemose, long ; bracts oblong entire, deciduous ; pistillate flowers solitary. *Male flowers* : calyx tube elongate, mouth shortly campanulate, limbs pentagonus, short. Corolla rotate, 5-partite, conpate at the base, segments obcuneate truncate, very long, fimbriate. Stamens 3, filaments inconspicuous ; anthers exerted, connate, liner, one 1-celled, the other two 2-celled, cells conduplicate. *Female flowers* : solitary. Calyx and corolla as in the male. Ovary globose one-locular ; style long, stigmas 3-lobed, lobes 2-fid exerted. Ovules 12, placenta 3, parietal with pair of ovules, attached on each side, horizontal, fruit large depressed globular, 12 grooved, flesh hard ; perfect seeds usually six each having a rudimentary or barren seed attached to its side, seeds flat ellipsoid.

Hodgsonia heteroclita H.f. & T. l. c. ; Kurz. in Journ. As. Soc. 1877. pt. ii ; Hk. f. Ill. l. c. Himal. Pl. t. 1. 23 ; *Trichosanthes heteroclita* Roxb. Fl. Ind. iii 705 ; *T. grandiflora*, Wall. Cat. 6685 not of Blume.

Vern. *Goolus* (Sylhet).

Stem extending up to 100 ft. Leaves alternate petiolate, 3-5 lobed, 3-5 nerved smooth on both sides, lobes entire, oblong or triangularly ovate, acuminate. Petioles shorter than the leaves, nearly round, reddish and smooth. Stipules solitary subaxillary, thick short, conical, coloured. *Male flowers* : racemes deep brown, axillary, about the length of the leaves, bearing several alternate, subsessile, very large flowers near the apex. Bracts solitary, oblong acute thick and firm, about $\frac{1}{2}$ inch in length. Calyx often rusty-pubescent outside, tube 2-3 by $\frac{3}{8}$ in. Corolla 5-partite inserted at the mouth of the calyx : segments subcordate, retuse with an acute point at the centre, corolla lobes 2 in., brown, villous, 3 nerved outside, white tinged with yellow inside. Stamens three arising from the mouth of the calyx tube ; anthers united forming a broad inverted cone ; variously grooved. *Female flowers* : calyx and corolla as in the male. Ovary inferior, broad cordate, deep brown, one-celled containing six pairs of ovules attached to the base of the parietal placentas. Style as long as the calyx tube and adhering to it, except on the base and apex. Stigma large three lobed ; lobes emerginate. Berry spheroidal, somewhat villous, apex sometimes pointed, about 5-6 inches in diameter when dry, brittle, one-celled. Mature seeds 6 ; seeds 2-3 by $1\frac{1}{2}$ in. convex or circular on the exterior edge, apex rounded and the base less so, the abortive seeds much smaller, but of the same form. Embryo erect. Cotyledons thick firm, white. Plumule of two unequal lobes. Radicle conical. Flowers December to August.

Habitat

Sikkim ; alt. 0-4,000 ft. ; Assam. Khasia Mts. alt. up to 3,000 ft. East Bengal and Chittagong : Pegu Martaban ; Kurz. Pinang and Malacca.

Occurrence

A native of the eastern parts of Bengal and Assam. From Sylhet Mr Robertkith Dick, the Judge of that district, sent plants to the Royal Botanic Garden, Calcutta, in 1805 where they blossomed during the greater part of the year and ripened in October. They grew to great lengths and remained alive for a number of years.

Sikkim Himalaya . . .	Sikkim 1-5,000 ft., Coll. J. D. Hooker ; hot valleys below Darjeeling 2,000 ft., July 1862, Coll. T. Anderson M. D. ; Balasun, Sikkim, 21-4-57.
Assam	Helio hill, N. E. of Lungleh, 3,700 ft., S. Lushai Hills April 3, 1899, Coll. A. T. Gage ; Dibrugarh bazar 18-11-11, Abor Expedition I. H. Burkill ; Aimamura, Coll. Dewar ; Tingali Bam Jungle, March 1899, Dr. Prain's collector ; Pobomukh, 15-12-11, Abor Expedition, Coll. J. H. Burkill ; Rajabari, 13 April, collected by Reporter on Economic Products, Government of India ; Ehekiajuli jungle, April 1902, Coll. A. C. Chatterjee ; Golaghat, 1891, Dr. King's collector; Nazira 250 ft., Sibsagar, Coll. C. B. Clarke ; Biknee 2,000 ft., Khasia and Jaintia Hills, 1878, Coll. Geo. Gallatly ; Khasia 1-4,000 ft., Coll. J. D. Hooker and T. Thomson.
Burma	Plumedal hills 3,000 ft., above the village, Pegu, Coll. S. Kurz ; Choungmenahchg, Coll. S. Kurz ; Kachin Hills, 1,300-2,000 ft., 28-3-97, Coll. E. Pottinger R.A.
Wall. Cat.	Wall. Cat. 6684 B, Sylhet ; Wall Cat. 6685, Penang ; Wall. Cat. 6684 A, Goalpara (Assam) ; Royal Bot. Garden, Calcutta, Wall. Cat. 6684 C.
Bengal	Rangamati, Chittagong Hill Tracts, 1876 ; Coll. J. L. Lister.
Malay Peninsula . . .	Setolanjet, Sumatra, 5th Aug., 1921 ; Kaula Manis Kelantan, 5th February 1923 ; Laurut, Perak, 100-500 ft., 1883, Coll. Dr. King's collector ; Batu Togh, 200 ft., Perak ; Malay, A. C. Maingay ; Perak, Coll. Rev. Father Scortechini ; Thujung, March 1884, Rev. B. Scortechini.

2. *Trichosanthes*

Trichosanthes Linn. Gen. p. 295 ; Reich. Gen. p. 503 : Thunb. Fl. Jap. p. 322 : Juss. Gen. p. 396 ; Lour. Fl. Cochinch. p. 588 ; Willd. Spec. **4,** p. 598 : Blume Bijdr. p. 932 : Ser. in DC. Prodr. **3,** p. 3131 ; Roxb. Fl. Ind. **3,** p. 701 ; Wight et Arn. Prodr. 1, p. 349 ; Meisn. Gen. p. 127 (91) : Spach veg. phan. 6, p. 192 ; Schrad. Reliq. in Linn. 12, p. 405 ; Endl. Gen. p. 939 : Arn. in Hook. Journ. of Bot. **3,** p. 277 ; Wight in Ann. and Mag. of Nat. Hist. **8,** p. 269 ; Duch. in Orb. Dict. **12,** p. 658 : Miq. Fl. Ind. Bat. **1,** part 1, p. 674 ; Naud. in Ann. sc. Nat. ser. **4,** p. 18. p. 188 : Benth. et Hook. Gen. Plant **1,** p. 821 ; C.B. Clarke in Hook. f. Fl. Brit. Ind. **2,** p. 606.—Anguina Micheli Nov. plant. Gen. p. 12, tab. 9 (1729).—Poppya Rumph. Herb. Amb. **5.** p. 414 (1747) ; Neck. Elem. **1,** p. 241 (non Roem.).—Cucumeroides Gartn. Fruct. **2,** p. 485 (1791). - Involucraria Ser. in Mem. Soc. phys. Geneve, **3,** part 1, p. 25, tab. 5 (1825) et in DC. Prodr. 3. p. 318 ; G. Don Gen. syst. 3. p. 42 ; Meisn. Gen. p. 127 (91) ; Roem. Syn. fasc. **2,** p. 97.

Scandent herbs. Leaves entire or 3-9 lobed, denticulate : tendrils single or 2-5 fid. Flowers dicœcious, sometimes monœcious. white. *Male flowers* : usually racemose (rarely solitary), often bracteolate, calyx tube cylindric, dialated above, 5-lobed. Corolla 5-lobed : lobes long, fimbriate. Stamens 3, inserted in the calyx tube ; filaments very short ; anthers almost included, connate (free in *Trichosanthes dioica*) one 1-celled, the others 2-celled the cells conduplicate ; connective narrow not produced. Rudimentary ovaries 3, filiform. *Female flowers* : solitary, calyx and corolla as in the male. Staminodes o. Ovary inferior, ovoid or fusiform, 1-celled, placentas 3, parietal ; ovules very many, horizontal or semi-pendulous ; style slender stigmas 3, entire or bifid. Fruit fleshy, globose, ovoid or fusiform, indehiscent, many seeded, usually smooth and glabrous. Seeds packed in pulp, ellipsoid, sometimes angular.

Habitat

Tropical Asia, N. Australia, Polynesia ; Species 40.

KEY TO THE SPECIES

I. Male flowers in racemes

A. Seeds much compressed, sometimes oblong, nonbelted
  B. Leaves entire
    C. Male racemes few flowered calyx teeth short . . . . 1. *T. nervifolia*
    CC. Male racemes many flowered calyx teeth long . . . . 2. *T. cuspidata*
  BB. Leaves lobed
    C. Male racemes ebracteate . . . . . 3. *T. cucumerina*
    CC. Male recemes with minute bracts
      D. Pedicels of the flowers much shorter than flowers .
        E. Fruits very long twisted . . . . . 4. *T. Anguina*
        EE. Fruit ovoid ellipsoid . . . . . 5. *T. pachyrrhachis*
        EEE. Fruit small ovate acute, leaves small . . . . 6. *T. brevibracteata*
      DD. Pedicles of the flowers long
        E. Leaves glabrous on both sides . . . . . 7. *T. Perrottetiana*
        EE. Leaves lower surface densely villose . . . . . 8. *T. villosula*
    CCC. Male racemes with large bracts
      D. Leaves at base truncate or narrowed
        E. Leaves ovate oblong bracts petiolate oblong lanceolate . 9. *T. truncata*
        EE. Leaves broadly ovate, bracts sessile ovate . . . . 10. *T. ovata*
      DD. Leaves at base deeply cordate
        E. Female flowers solitary, ebracteate
          F. Calyx segments entire
            G. Leaves entire, ovate triangular; bracts entire . . 11. *T. cordata*
            GG. Leaves shortly lobed; bracts crenate or incised
              H. Leaves not hairy on the upper surface . . . 12. *T. Wallichiana*
              HH. Leaves hairy at nerves on upper surface
                I. Leaves large 5-lobed . . . . . 13. *T. majuscula*
                II. Leaves small, 9-15 lobed . . . . . 14. *T. khasiana*
          FF. Calyx segments dentate or lacinate
            G. Bracts oblong lanceolate subentire . . . . 15. *T. tricuspidata*
            GG. Bracts broad, dentate or incised
              H. Calyx segments shortly dentate . . . . 16. *T. pubera* (*bracteata*)
              HH. Calyx segments deeply 3-5 lobed . . . . 17. *T.* Lepiniana
        EE. Female flowers racemose, bracteate . . . . . 18. *T. anamalaiensis*
AA. Seeds turgid with thick longitudinal belts
  B. Leaves deeply trilobed . . . . . 19. *T. himalensis*
  BB. Leaves entire . . . . . 20. *T. dicaelospermum*

II. Male and female flower solitary

A. Leaves at base cordate, margin-dentate
  B. Leaves cordate, ovate oblong; petals fimbriate . . . . 21. *T. dioica*
  BB. Leaves reniform; petals entire or lacinate . . . . . 22. *T. integrifolia*
AA. Leaves at base round, margin entire . . . . . 23. *T. Thwaitesii*

1. ***Trichosanthes nervifolia*** Linn. sp. Pl. 1008; *Trichosanthes cuspidata* Lamk.; Trim. Ceyl. **2,** 244; Vern.: Hind. *Parvar, Paval;* Beng. *Potol*; Tam. *Kombu-pudalai;* Tl. *Kummu-potta;* Kan. *Podla Kayi.*

Perennial; stems twining glabrous somewhat woody below, much branched; branches slender, striate, glabrous dicœcious. Tendrils 2-fid, glabrous. Leaves entire 2-4 by 1-2½ in. ovate oblong (not lobed), acute, mucronate, the margins minutely and remotely denticulate, glabrous on both surfaces, dark green above, paler beneath, base cordate; main nerves 3, from the base, the two lateral ones not quite reaching the apex, with strong secondary nerves on the outside, the lowest pair of secondary nerves conspicuously branching into the basal lobes of the leaves at either side of the sinus; petiole ½-1 in. long. *Male flowers*: in axillary 4-10 flowered corymbose racemes; peduncles slender, sulcate, 1-2½ in. long; petioles ⅛-⅓ in. long; bracts minute caducous. Calyx tube puberulous, ⅔-1¼ in. long., very narrow, about ⅛ in. wide at the mouth and $\frac{1}{10}$ in. wide in the middle; teeth short linear, acute $\frac{1}{16}$-$\frac{1}{10}$ in. long. Petals ovate-oblong, acute, fimbriæ at the apex much branched

and much longer than the blade of the petal. *Female flowers* : axillary, solitary, on both peduncles. Calyx tube nearly 2 in. long, much produced above the ovary. Fruit 1½-3 in. long, ellipsoid, shortly beaked tapering to both ends, green with white lines when immature, scarlet when ripe ; pericarp thin. Seeds semi-ellipsoid ⅜-½ in. long, compressed, thickened at the margins each enclosed in an envelope of scarlet pulp. Flowers November to December.

Habitat

Deccan Peninsula ; Quilon, Wight ; Coorg (tropial region), G. Thomson ; Ceylon, not uncommon up to 5,000 ft., Thwaites.

The species is restricted principally to Peninsular India and Ceylon, even there it is not very widely distributed.

Medicinal uses

The medicinal properties of this species are allied to that of *Trichosanthes dioica.*

Occurrence

Peninsular India . . . Kavalay Cochin 2,000 ft., November 1910, Coll. A. Meebold ; Nilgiri, Coll. G. Thomson ; Astoli, Belgaum Dist., Nov. 21, 1889, Coll. W. A. Talbot.

2. ***Trichosanthes cuspidata*** Lam. Encycl 1,188 ; Meth. Bot. 1. p. 188 ; Cogniaux (1881), p. 357. Ser. in DC. Prodr. **3,** p. 311 ; W. & Arn. Prodr. 1, p. 349 ; Roem. Syn. fasc. **2,** p. 95 ; Rheed. Hort. Malab. **8,** p. 31. tab. 16 ; *T. caudata* Willd. sp. pl. **4,** p. 600.

Stem slender, elongate, branched, channeled, glabrous, smooth. Petiole slender, furrowed, glabrous ½-1 cm. long. Leaves upper surface deep green, lower surface pale green, 8-10 cm. long, 4-5 cm. broad base 5-nerved ; veins not prominent, lower prominent and thinly reticulate ; lobes at the base broadly round, 1 cm. deep. Tendril delicate, short, furrowed, glabrous bifid. Common male peduncle slender, furrowed, glabrous. Male racemes many flowered. Flowers at the base almost continuous, 4-7 mm. ; bracteole about ½ mm. long. Calyx tube filiform, apex dilated, 12-14 mm. long, apex 1½ mm. and middle ⅓-½ mm. broad ; teeth erect 2-2½ mm. long. Staminal filaments ½ mm. long, anther hard oblong linear, 3½ mm. long, 1 mm. broad. Fruit glabrous, smooth turbinate-ovate, apex long appendiculate.

Habitat

In Eastern India at Quilon (Wight n. 1135 in Herb. Kew. deless. Hort Petrot., Vindar). From Cogniaux Cucurbita p. 357.

3. ***Trichosanthes cucumerina*** Linn. Sp. pl. 1008. Roxb. Fl. Ind. iii 702 ; Wall. Cat. 6190 A.B.C.D. E. ; Blume Bijd. 933 ; Dalz. & Gibs. Bomb. Fl. 102 ; Miq. Fl. Ind. Bat. i, pt. i 676 ; Naud. in Ann. Sc. Nat. Ser. 4, xviii 191 ; Kurz in Journ. As. Soc. 1877, pt. ii, 98. *Trichosanthes lobata* Roxb. *T. laciniosa* Klein in Herb. Rottler ; *Bryonia umbellata* Wall. Cat. 66770 D ; *Cucumis Missonis* Wall. Cat. 6728 ; *Trichosanthes reniformis* Miq.

Vern. Sans. *Patola ;* Beng. *Banchichinga, banpatol ;* Hind. *Jangli-chikanda ;* N. W. F. *Jangli chichinda, banpatol, kandori ;* Pb. *Ban-goal kakri. Moaakin ;* Bomb. *pan parul, jangli padavala, Kalu-padavala ;* Mar. *Ranachapadawali. Kalupadavala, peypwal, pedel ;* Tel. *Adavipatla, Chedupotla, pato-lame ;* Kan. *Bettadu-padavala ;* Malay. *Kaippam-patolam ;* Burma. *Topelenmoye.*

A pretty extensive climbing annual dioecious or monœcious ; stamens 12-15 ft. long, slender, furrowed slightly hairy, subglabrous, leafy. Tendrils 2-3 (usually 3) fid. Leaves 2-3 in. long, usually little broader than long, orbicular-reniform or broadly ovate, distantly denticulate, more or less deeply 5 or less deeply 5 (rarely 3-7) lobed, the lobes broad, acute, glabrous or nearly so above, more or less pubescent, or when old, sometimes scabrid beneath, base deeply cordate the sinus often subrectangular : petioles 1-3 in. long, striate, pubescent. Male flowers in axillary racemes with

sometimes a solitary male flower from the same axil as the raceme ; peduncles of the racemes 2-6 in. long, slender, striate bearing 8-15 flowers near the apex ; pedicels puberulous, $\frac{1}{3}$-$\frac{3}{4}$ in. long ; bracts 0. Calyx tube dilated at the apex, $\frac{3}{4}$-1 in. long, about $\frac{1}{8}$ in. wide at the mouth ; teeth short acutely triangular. Petals white $\frac{3}{8}$ in. long, lanceolate oblong, laciniate at the apex. Female flowers axillary, solitary or occasionally a female flower in the same axil as the male peduncle ; peduncles of female flowers $\frac{1}{3}$-$\frac{5}{8}$ in. long. Fruit 1-3 in. long ; ovoid fusiform, tapering at both ends and with a long sharp beak, green and striped with white when immature, scarlet when ripe ; pericarp thin. Seeds semi-ellipsoid, compressed, involved in red pulps. Flowers July to October.

Habitat

Found throughout India and Ceylon ; distributed to Malay and N. Australia.

Medicinal uses

The patola of Sanskrit writers, a plant which is mentioned by *Chakradutta* as febrifuge and laxative, is said by Dymock to be referred in Bombay to this species. In Bengal, on the other hand, *Trichosenthes dioica* is believed to be the Sanskrit patola. Whatever this species may be, the species under consideration is supposed to possess several valuable properties. Thus Ainslie writes, ' The tender shoots and dried fruits are very bitter and aperient, and are reckoned amongst the stomachic laxative medicines ; they are used in infusion to the extent of 2 ounces twice daily '. In South India, the seeds are considered to be a remedy for disorders of the stomach, antifebrile and anthelmintic ; the tender shoots and dried fruits are believed to have the qualities described by Ainslie, and are given in decoction with sugar to assist digestion ; the juice of the leaves is thought to be caustic, and the root purgative, the petiole of the leaf in the form of a decoction is a reputed expectorant. According to Dymock, the plant has a reputation as a febrifuge in Bombay and is given in decoction with ginger, chiretta and honey. ' Muhammadan writers described it as cardiac tonic, alterative, antifebrile, and a useful medicine for boils and intestinal worms'. In the Konkan the leaf juice is rubbed over the liver, or the whole body, in remittent fevers. ' The juice of the leaves and fruits is useful in cases of congestion of the liver and bilious headache ; it also acts as a laxative.' (Civil Surgeon J. H. Thornton.)

Occurrence

Malay Peninsula	Perak, within 500 ft., open grazing ground, March 1884, Dr. King's collector Java, 1859 ; Viti and Fiji Isls., Coll. B. Seemann, 1860.
Peninsular India	Koni, Travancore State, 25-8-1913, Coll. C. C. Calder & M. S. Ramaswami ; Vellapatti 1,600 ft., Coimbatore Dist. 27-9-1710, Coll. C. E. C. Fischer ; Mysore and Carnatic, Coll. G. Thomson ; Pimpuyaum, north of Nasik, Bombay 1878 ; Karwar, North Kanara, 15 July 1883, Coll. W. A. Talbot ; Badami, S. India, Sept. 1910, Coll. A. Meebold ; Aiyarangal 1,200 ft., Anaimalai, S. India, Coll. C. E. C. Fischer.
Assam	Kobo, Abor Expedition, 18-12-1911, Coll. I. H. Burkill ; Assam, Coll. Griffith.
Bengal	Sundribans, 27-8-1897, Coll. Janardan ; N. Bengal, between Dingra Ghat and Purnea ; W. Bengal in hedges around villages, Coll. S. Kurz.
Bihar	Manbhum Coll. Rev. J. Campbell, base of Pareshnath 13-11-58.
Gangetic Plain	Coll. T. Thomson ; Banda, U. P. Coll. Mrs. A. S. Bell ; Lucknow, Aug. 1854.
N. W. Himalaya	Near Dehra Dun, July 1882, Coll. Duthie ; Coll. P. W. Mackinon ; Sagalwas Forest 8,500 ft., Chamba (Punjab) 15-9-99, Coll. Harsukl ; Aboo 1868, Aug. 1868, Coll. G. King ; Anadru, Aug. 1808, Coll. G. King ; Dehra Dun 1869, Coll. G. King ; Dalhousie Coll. Dr. Clarke ;
C. I.	Guna, Gwalior.
Burma	Maymyo Plateau, 3,500 ft., July-Aug. 1908, Coll. J. H. Lace ; Minbu, Sept. 1902, Coll. Shaik Mokim ; Shan hills 1892 Abdul Haque ; Bhamo 4-2-68, Coll. J. Anderson.
Sikkim Himalaya	1879, Coll. G. King ; Selim 1,000 ft., Sikkim, 18 Oct. 1884, Coll. C. B. Clarke ; Rungiet 500 ft., Darjeeling 20 Sept. 1869 ; Rongtsong below Mungpoo 16 Dec. 1876, Coll. A. B. ; Sikkim 5,000 ft., 23-9-35, Coll. G. King ; Teesta 2,000 ft., 12-8-14, Coll. G. H. Cave ; Pankabari 1,000 ft., 8 Aug. 1875, Coll. Gamble ; neighbourhood of Kalimpong, January 1901, Coll. P. C. Lyons.
Wall. Cat.	Madras 6728 ; Monghyr 6691 ; Royal Bot. Garden, 6693.
Siamese Peninsula	Chingmai 1,000 ft., 7th July 1909, Coll. A. F. T. Kerr.

4. ***Trichosanthes Anguina*** Linn. Sp. Pl. 1008 ; Fl. B.I. **2,** Grah. Cat. p. 78 ; Dalz. & Gibs. Suppl. p. 37 ; Duthie, Field and Gard. Crops, t. 46 ; Woodr. in Journal Bomb. Nat. **11,** (1898) p. 639, & Gard. in Ind. ed. 5, p. 330 ; Watt. Dict. Econ. Prod. 6, part 4, p. 81 ; Kundu. J. Bombay Nat. Hist. Soc. 1942, **43,** 374.

The Snake Gourd. Vern. Sans. *Chichinda ;* Hind. *Parwal, chachinga ;* Beng. *chichinga ;* Uriya. *Chachainda ;* N. W. P. *Jhajhinda ;* Oudh. *Chichinga ;* Pb. *Galar tori, andol, chichinda ;* C. P. *Pudoba ;* Bombay. *Pandolu, padval ;* Burma *Pai-len-mwae.*

Annual, monœcious ; stems 12-15 ft. long, slender, furrowed, slightly hairy, subglabrous. Tendrils 2-3-(usually 3) fid. Leaves 2-5 in. long, usually a little broader than long, orbicular reniform or broadly ovate, distantly denticulate, more or less deeply 5 or less deeply 5-(rarely 3-7) lobed, the lobes broad, glabrous or usually so above, more or less pubescent, or when old, sometimes scabrid beneath, base deeply cordate the sinus often subrectangular ; petiole 1-3 in. long, striate, pubescent. *Male flowers* in axillary racemes, with sometimes a solitary male flower from the same axil as the raceme ; peduncles of the racemes 2-6 in. long, slender, striate bearing 8-15 flowers near the apex ; pedicles puberulous, $\frac{1}{3}$-$\frac{3}{4}$ in. long, bracts 0. Calyx tube dilated at the apex $\frac{3}{4}$-1 in. long, about $\frac{1}{8}$ in. wide at the mouth ; teeth short, acutely triangular. Petals white $\frac{3}{8}$ in. long, lanceolate oblong, laciniate at the apex. *Female flowers* axillary, solitary or occasionally female flowers $\frac{1}{8}$-$\frac{5}{8}$ in. long. Fruit long, often attains a length up to 3 ft., with a thickness of about $1\frac{1}{2}$ in. diameter, somewhat rotate ; when green with white stripes from base to apex. C. B. Clarke is of opinion that it may be a cultivated form of *Trichosanthes cucumerina* with which it conquers in all aspects of its vegetative and reproductive organs except the fruit which is often very long. It is seldom found in wild state and is extensively cultivated throughout India as a rainy season crop. The general treatment and mode of cultivation is the same as that of the cucumber. Flowers June to August.

Habitat

India—cultivated. Distributed to China and Malaya.

Medicinal use

The seeds are considered cooling. Food : The long fruit is cooked and eaten as a vegetable either boiled or in curries. When ripe it turns brilliantly orange in colour. Owing to the resemblance of the fruit with the horn of deer or buffalo this fruit is not taken by certain superstitious Hindu widows of India.

Distribution

Wall. Cat. : Gangachora, 9th June 1809, 6687 C ; 6687 A. U. P. : Banda, vern. *Chachingra*, Aug. 1902, Coll. Mrs. A. S. Bell.

N. W. Himalaya : Dehra Dun July 1884, Coll. Duthie ; Shangai 1860, Coll. Maingay.

5. ***Trichosanthes pachyrrhachis*** Kundu in Journ. Bot. 1939, 77,9. Stem delicate, deeply angled, glabrous or slightly hairy. Leaves membranous, suborbicular or reniform, with a cordate base densely covered with hairs, very shortly 3-5-lobed, lobes subacute ; margin denticulate ; $1\frac{1}{2}$ to $2\frac{1}{2}$ in. in length, 2-3 in. broad. Petiole slender, $\frac{1}{2}$ to $1\frac{1}{2}$ in. length. Tendrils, grooved, puberulous 3-fid. Flowers monœcious. Male racemes 10-15 flowered ; rachis robust, somewhat geniculate, sometimes nearly as thick as the stem succulent, slightly grooved, glabrous 3-$4\frac{1}{2}$ in. long usually flowering from near the base. Pedicels terate, robust, erect slightly puberulous $\frac{1}{8}$ to $\frac{1}{7}$ in. long. Calyx tube short, dilated at the apex. Petals oblong staminal filaments slender very short. Female flowers not seen. Fruiting pedicel solitary 1·5 in. long. Fruits ovoid ellipsoid, attenuate into an acuminate apex ; epicarp thin. Seeds flattened with undulate margins, truncate at the base bidentate at the apex about $\frac{1}{2}$ in. long and $\frac{1}{3}$ in. broad.

Habitat

N. W. India ; Burma ; N. Bengal.

6. ***Trichosanthes brevibracteate*** Kundu in Journ. Bot. 1939, 77,10.

Stem very slender, grooved subglabrous. Leaves membranous, very thin, 3-5 angled or very shortly five-lobed, reniform, apex acute, base cordate emerginate, margin dentate, on the upper surface covered with minute hairs ; deep green on the upper surface, pale green on the lower surface ; 3·5-7·5 cm. long, 4·5-9 cm. broad, 3-5-nerved at the base ; veins very thin prominent on the lower surface. Petiole slender striate, 2-4·5 cm. long. Tendrils slender 2-3-fid. Monœcious or diœcious. Male flowers in racemes. Rachis bearing male flowers slender, striate puberulous 5-10½ cm. long, 5-10 flowered at the apex. Pedicels slender erect or spreading puberulous 5-15 cm. long. Calyx tubular, teeth spreading. Petals oblong 8-10 mm. long 3 mm. broad, staminal filaments slender, about 2 mm. long ; anther head oblong 2½ mm. long, 1¼ mm. broad. Female flowers not seen. Fruiting peduncles solitary 8-10 mm. long. Fruit ellipsoid, attenuate into a conical apex 3½-4½ cm. long, 1½-2½ cm. thick with about 7-8 seeds. Seeds flattened, oblong, subglabrous on both surfaces, somewhat undulate at the margins, base and apex truncate, 10 mm. long, 6·6 mm. broad, 2 mm. thick.

Distribution

Karnal, Punjab ; Ahmedabad, N. W. India ; Koni, Travancore, S. India ; Kanara.

7. ***Trichosanthes Perrottetiana*** Cogn. in DC. Monogr. Phan. III 362 ; leaves subcoraceous, round ovate-suborbicular, margin distantly subulate denticulate, base occasionally deeply emarginate, both sides glabrous or smooth, commonly trilobed at the middle, lobes oblong-triangular, acuminate ; male racemes many flowered ; pedicels long, base minutely bracteate ; calyx shortly puberulous, teeth longish, linear.

Stem often slender, branched, angular, glabrous or slightly puberulous. Petiole slender, striate subglabrous, 5-7 mm. long. Leaves upper surface deep green, lower pale green, dilated at the base, 12-14 cm. long, 10-12 cm. broad, intermediate lobes longish ; indentations narrow, acute, base broadly round, 1½-2 cm. deep, 4-5 cm. broad ; veins narrow lower veins prominent and reticulate. Tendrils robust elongate, deeply channeled, somewhat puberulous, 3-fid. Common peduncle of the male flowers very slender furrowed, glabrous or slightly puberulous, 10-15 flowered, 15-20 cm. long, pedicles slender, bract 5-10 cm. long ; bracts subulate caducous 3-5 mm. long calyx subcylindrical, apex constricted, longitudinally 10-nerved, 1½-2 cm. long, apex 3 mm. and at the middle 1½ mm. broad ; teeth erect 4-5 mm. long. Staminal filaments slender 2 mm. ; thick. Pistillate 5-6 mm. long. Female flowers unknown.

Habitat

In Eastern India, near Pondichery (Perrottett n. 256 in Herb. Bois and Vindab.).

8. ***Trichosanthes villosula*** Cogn. in DC, Monogr. Phan. III 362 p. 262.

Leaves membranous, round suborbicular, upper surface slightly puberulous or scabrous, lower densely villose hirsute, 5-lobed, lobes ovate oblong, acute or shortly acuminate, male racemes many flowered pedicles long, base minutely bracteate ; calyx slightly long villose, with elongate teeth, subulate.

Stem slender, elongate, branched, angularly sulcate, with thin long hairs, Petiole very slender, striate, with sparingly long hairs, 3-6 cm. long. Leaves upper surface bright green, lower surface as the upper, 8-12 cm. long as well as broad ; lobes occasionally lobulate, upper nerves thin, lower prominent and reticulate. Tendril robust, elongate, sparingly villose, 3-4 fid. Common peduncle of the male, narrow, channeled. Slightly villose, 12-20 flowered, 10-16 cm. long ; pedicles erect ascending subfiliform 2-5 cm. long ; bracts subulate, caducous, 1-2 mm. long. Calyx tube subcylindric, upper dilated, apex constricted, longitudinally 10-ribbed, 2-2½ cm. long, apex 5 cm. and at the middle 2 mm. broad ; teeth 5-7 mm. long ; petals oblong-lanceolate, tri-nerved, acuminate 12-13 mm. long, 3-4 mm. broad ; fimbriate, elongate, divided. Stamens : filaments filiform 1-1½ mm. long ; anther head sublinear, 5 mm. long 1½ mm. thick. Pistillode 8-9 mm. long. Female flowers unknown.

Habitat

Eastern India at Mount Nilgiri.

9. ***Trichosanthes truncata*** C. B. Clarke. in Hook. f. Fl. Brit. Ind. ii 608.

Stem twining ; tendrils 2-3 fid. Leaves ovate from a truncate hastate or obrus (not cordate) base sometimes subpeltate entire or irregularly tricuspid glabrous coriaceous or membranous, polymorphous, sometimes exactly ovate with a rounded sub-entire-margin. Bracts ovate slightly serrate nearly glabrous. Male peduncle 6 in. calyx tube ¾-1½ in. somewhat tomentose without ; corolla greenish white. Female plant unknown. Flowers March to June.

Habitat

Occurs in Sikkim upto an elevation of 1,000 ft. Khasia Hills 4,000 ft. H.f. & T. ; C. B. Clarke.

Occurence

Sikkim	Rishap 1,500 ft., Darjeeling 10 March 1871, Coll. C. B. Clarke ; Sikkim Himalaya Coll. G. King ; Riyang, 8-4-1876, Coll. G. King ; Joke, Sikkim Coll. S. Kurz , Ramno, Nov. 1857 ; Gouk 4,000 ft., 15-6-1862, Coll. T. Anderson ; Riyang Valley, April 1878, Coll. J. L. Lister.
Assam	Khasia Hills, Coll. Simons ; Mount Khasia, 4,000 ft. Coll. J. D. H. & T. T., Konoma, Naga Hils, Aug. 1886, Coll. Dr. D. Prain.
Burma	Kachin Hills, Sadar, March 1898, Coll. Shaik Mokim.

10. ***Trichosanthes ovata*** Cogn. in DC. Monogr. Phan. III, p. 365 ; leaves membranous, entire, broadly ovate, apex shortly acuminate, base round or truncate, margin minutely remotely denticulate both sides glabrous ; tendrils 2-3-fids ; male racemes subcapitate, few flowered ; bracts ovate, subsessile.

Stem robust elongate, branched, angularly furrowed, glabrous or puberulous. Petiole robust, furrowed, glabrous 3-5 cm. long. Leaves upper surface bright green, lower pale green, 14-18 cm. long, 11-14 cm. broad base trinerved, veins thin lower prominent and reticulate, lateral nerves bifurcate. Tendrils slender, sufficiently elongate, glabrous. Common male peduncle very robust, furrowed, glabrous, apex 6-10-flowered, 10-15 cm. long ; pedicels very narrow, shortly villose, 1-2 mm. long ; bracts acute, base round, entire or slightly undulate, three nerved, 12-13 mm. long, 8-10 mm. broad. Calyx tube shortly tomentose, upper dilate ; teeth erect or reflexed, linear 7-9 mm. long, 1½ mm. broad. Corolla shortly tomentose. Female flowers and fruits unknown.

Habitat

In Sikkim (Thomson in herb. Hort. Petrop. et Lugd. Bat.).

11. ***Trichosanthes cordata*** Roxb. Hort. Beng. 70 ; Fl. Ind. iii 703 ; *Trichosanthes tuberosa* Roxb. ; *T. palmata* Wall. Cat. 8668 F. partly & C.

Vern. Beng. *Bhui kumra, bhumi kumra, patol.*

An extensive climber. Root tuberous, perennial, growing to the size of a man's head. Stem herbaceous, climbing to a considerable length, five angled, villous or even somewhat scabrous when old. Tendrils opposite, three cleft. Leaves often 6-8 in. alternate, petioled, cordate ovate acute entire or obscurely angular lobed, hairy beneath, dentate serrate. Petiole channeled, a little hairy, scarcely half the length of the leaves. Male peduncles usually paired, the racemed one axillary, solitary as long as the leaves. Bracts alternate, sessile, cuneate, oblong, acute, serrulate, one-flowered. Flowers large white, the fringe of the segments coarser. Female flowers axillary, solitary, short peduncled. Calyx tube 1½ in., densely hairy outside, segments finely acuminate. Fruit spherical, of the size of an orange, and of nearly the same colour, and as in *T. pubera* of which it is much alike, the cells and partitions are very obscure. Seeds numerous, veins immersed in soft gelatinous green pulp. *var. subpedata ;* leaves pedately lobed almost to the base, Cachar, C. B. Clarke. Flowers May to August.

Habitat

Met with at the base of the Eastern Himalaya, from Sikkim to Assam and Pegu ; frequent in the Khasi ; Terai and Assam.

Medicinal uses

The large tuberous root is considered a valuable tonic and is employed as a substitute for Calcumba (Roxburgh). According to Irvine (ex Watt D. E. P.) it is a deobstruent and in Patna the dried flowers are believed to be stimulent in doses of 2 to 5 grains. Taylor states that in Dacca the root, dried and reduced to powder is given in doses of 10 grains in enlargement of the spleen, liver, and abdominal viscera. The fresh root mixed with oil, forms a common application in leprous ulcers.

Occurrence

Peninsular India	Chodavaram—foot of Rampa, Madras Presidency, 7th Aug. 1914, Coll. M. S. Ramswami.
Burma	Martaban, Coll. S. Kurz; Banks of Sittong, Peu, Coll. S. Kurz.
Assam	Nambar forest 9th May 1895 Collected by the Reporter of Economic Products to the Governmnet of India; Mount Khasia 0-4,000 ft., Coll. J. D. H. & T.T.; Nazira 250 ft., Sibsagar, 23 April 1885, Coll. C. B. G. Clarke; Kohima 4,500 ft., Naga Hills, July 1886, Coll. Dr. D. Prain; Saikhowa below Sadiya, 25 Aug. 1909, Coll. I. H. Burkill.
Sikkim	Tista valley, 4,500 ft., 5-7-09, Coll. Smith & Cave; Sikkim, Coll. S. Kurz.; Darjeeling Terai 500 ft. 12 June 1870, Coll. C. B. Clarke
Bengal	Bhunraj, Dacca 15th Sept., 1868
Malay Peninsula	Singapore, January 1890; Pulan Ubain, February 1890, Coll. H. K. R.
Wall. Cat.	Sylhet 6686 B; R. B. Garden, Calcutta 6686 A
U. P.	Hardwar Dehra Dun, Aug. 1870, Coll. G. King; near Dehra Dun, July 1882, Coll. J. J. Duthie.

12. ***Trichosanthes Wallichiana*** Wight in Ann. & Mag. Nat. Hist. ser. I. viii (1842) 270; *Trichosanthes multiloba* C. B. Clarke; *T. grandibracteata* Kurz. in Journ. As. Soc. 1877, p. ii, 99 ex descr.

An extensively rambling shrub. Dioecious. Leaves deeply (only half way down) palmate in 5 or 3-9 lobes narrowed near their base 3-6 in. diam., usually glabrous beneath or less commonly scabrous with scattered bristles, subcordate at the base; segments serrate (sometimes lobed) ascending, less divaricate than in *T. palmata*, acute; petiole 1-3 in., often with several large glands near the apex; tendrils commonly 3-fid. Bracts ovate or obovate deeply serrate. Male peduncles usually paired, the racemed one 6 in., naked below. Calyx tube 1-2½ in.; teeth lanceolate, subulate, entire. Fruit 2-4 in., ovoid or oblong acute bright red with orange streaks. Seeds ⅝-¾ in. more or less angular on the margins very many in green pulp. This is rather a variety of *T. pubera* (*T. palmata* Roxb.), the Himalayan large form of which so closely resembles it, that in the absence of the fruit it cannot always be distinguished from it.

Habitat

Sikkim, East Himalaya, Khasia Mts.; alt. 2,000-6,000 ft.; plentiful Malacca? Maingay 671 Distributed to China and Japan.

Occurrence

Burma	Kachin Hills, Upper Burma, January 1898, Coll. Shaik Mokim; Meywar, Burmah, 6th October 1868, Coll. D. J. Anderson.
Malay Peninsula	Perak, Rev. Father Scortechini; S. Pahang Aug. 1891, Coll. Huk; Palan Penang May 1893, Coll. C. Curtis; Singapore 1893.
Assam	Shillong 6,000 ft., 10 Aug. 1885, Coll. C. B. Clarke; Shillong, 4 June 1911, Coll. R. K. Das; Dumpet 30 May 1911, R. K. Das; Mount Khasia 0-5,000 ft., Coll. J. D. H. & T. T.; Khasi Hills, 5,000 ft., Tingale Bam jungle March 1899, Coll. Dr. Prain's collector; Khasi Hills 500 ft., June 1876.
Bihar	Chota Nagpur, Coll. J. J. Wood.
Peninsular India	N. Kanara, Bombay, May 5, 1889, Coll. W. A. Talbot.

Sikkim	Mungapoo, Bhulkiya, 3,000 ft., 18 July 1914, Vern. (Nepal) Indrayni, Coll. C. W. C. ; Phadonchen 7,000 ft., 20 Aug. 1910, Coll. W. W. Smith ; Sikkim Himalaya, Coll. G. King. Tumlong, 5,500 ft., 10 July 1892, Coll. G. A. Gambie ; Sikkim 4,000 ft., 25 January Coll. G. King ; Runghee 5,000 ft., Darjeeling, 23 July 1870, Coll. C. B. Clarke ; Punkabari 500 ft., Darjeeling 4 Sept. 1879 ; Sikkim Himalaya, Coll. S. Kurz ; Rishap 3,000 ft., Darjeeling 2 Aug. 1870, Coll. C. B. Clarke ; East Himalaya, distributed at the Royal Bot. Garden, Kew, Coll. Griffith ; Sikkim 2-6,000 ft., Coll. J. D. Hooker.
Assam	Haflong, 2,500 ft., N. Cachar, 2 Nov. 1908, Coll. G. A. Craib.
N. W. Himalaya . . .	Near Mussoorie, 1869, Coll. G. King, Simla 1886 Coll. Collett. ; N. W. India Royle.

13. ***Trichosanthes mojuscula*** Kundu in Journ. Bot. 1939, 77, 12.

T. Wallichiana Weight var majuscula Clarke, Cogn. in DC. Monog. III 369 ; *T. multiloba* Miq. var. majuscula Clarke in Hook. F.B.I. II, H.N.R.

Stem rather stout, elongate, ribbed, glabrous. Leaves large, membranous, glabrous and smooth on the lower surfaces, slightly hairy at the nerves on the upper surface, deeply palmately 5-lobed. Petiole very stout striate or covered with minute hairs, 6-6·8 cm. long. Tendrils stout and woody, ribbed slightly hairy, branched. Male flowers in racemes ; rachis short and woody many flowered, grooved. Pedicels short ; calyx tube about 6 cm. long 1 cm. broad at the apex, spreading. Female flowers unknown.

Habitat

Khasi Mts., Assam 4,000 ft.

14. ***Trichosanthes Khasiana*** Kundu in Journ Bot. 1942, 75, 9-12.

Stem robust, elongate, angulate, grooved, glabrous. Leaves membranous, ovate suborbicular. Sparingly hairy at the nerves on the upper surface glabrous on the lower surface, deeply palmately 3-lobed near to the base, sometimes an additional short lobe occur on the side of the each of the lateral ones, 9-15 cm. long 8-13 cm. broad. Petiole stout, striate 2·5-5 cm. long. Male racemes loosely flowered at the apex ; rachis very stout. Bracts glabrous, ovate, calyx tube puberulous 4·5-5 cm. long 8·5-10 mm. broad. Peduncle of the female flower 1·5 to 2·5 cm. long. Calyx tube cylindrical ovary fusiform, glabrous. Fruits oblong ellipsoid, slightly tapering on both ends 5-16 in. long. Seeds irregular, margin smooth 10-14 mm. long, 5-8 mm. broad and 2 mm. thick.

Distribution

Khasi mountains.

15. ***Trichosanthes tricuspidata*** Lour. Fl. Cochin **2,** p. 588 ; edit. Willd. p. 723. Willd. spec. 4,p. 600 ; Bl. Bijdr. p. 935 ; Ser. in DC. Prod. 3, p. 305, Roem. Syn. fasc. 2, p. 95 ; Miq. Fl. Ind. Bat. 1, part 1, p. 676. Leaves coriaceous, broadly ovate-triangular, both sides glabrous or smooth, trilobate, lobes broadly triangular, acute or shortly acuminate, margin entire or obscurely undulate denticulate ; tendril trifid ; male racemes many flowered ; bracts oblong ; lanceolate ; rarely ovate oblong, subentire or shortly broadly dentate ; calyx tube narrowed from apex to base, teeth elongate triangular lanceolate, shortly denticulate.

Stem robust, elongate, branched, furrowed, glabrous, smooth. Petiole very much narrow, angularly furrowed, glabrous 4-6 cm. long. Leaves upper surface intensely green, lower surface pale green ; base pedate 5-7 nerved, 10-16 cm. in breadth, lobes divergent, intermediate one longer, indentation between the lobes broad ; obtuse or subacute, base angular 2-3 cm. deep ; nerves of the upper surface robust, lower surface prominently reticulate. Tendrils robust, elongate, angular, subglabrous. Common peduncle of the male, furrowed, glabrous or slightly puberulous, flowers profuse from middle to the apex, bearing 10-25 flowers, 12-20 cm. long, bracts arising from the base, bracts hard, rigid smooth, ovate oblong, obscurely dentate 1 cm. long, pedicles very much narrow, erect spreading, apex dilated, flexuous 3-8 cm. long ; bracts shortly densely villose, many nerved, 2 cm. long ; calyx tube shortly densely tomentose 7-8 cm. long, 3-4 cm. broad. Staminal filaments very short, anther head 9-10 mm. long, 2·5-3 cm. broad. Female flowers unknown ; fruit ovoid, acute, small yellow. Flowers April to October.

Habitat

Malay Peninsula . . . Bukil Cheras, Pahang, 10 Oct. 1931, Coll. M. R. Henderson; Polo Boetong, Aug. 1879, Coll. C. Curtis; Singapore, January 1885; Lurul Perak 1,000-1,500 ft., Aug. 1801, Dr. King's collector; Kilan Tujor April 1892, Coll. L. Wray (Jr.)

16. ***Trichosanthes pubera*** Blume, Bidjr. 936; *Trichosanthes palmata* Roxb. Fl. Ind. iii. 704; *T. laciniosa*, Wall Cat. 6689 A.B.; *T. aspera*, Heyne in Herb. Rottler; *T. tricuspis* Miq. Fl. Ind. Bat. i. pt. i, 679; *T. cordata* Wall Cat. 6686 exel. A. and B.; *T. anguina* Wall. Cat. 6687, F partly; *T. bracteata*, Voigt Hort. Sub. Calc. (1845) p. 58; *Cucurbita Melopepo*, Wall. Cat. 6725; *Involucraria Wallichii* Seringe in DC. Prodr. iii 318; *Bryonia palmata* Wall. Cat. 6711 F.

Vern. Sans.-*Mahakala*; Hind.-*Lal-Indrayan, indrayan, makal*; Beng.-*Makal*; N.W.P.-*Indrayan, makhal, parwar, palwal*; Kumaon-*Indrayan*; Bomb.-*Kaundal*; Mar.-Kavandala Tam.-*Korattai, uncoruthai*; Telegu-*Mahakavaduta*; Kan.-*Avagude-hannu*; Arb.-*Aubghol*; Pers.-*Hhnsle-Surkh.*

An extensive climber, often attaining a height of 30 ft.; stamens robust woody below, branched, grooved, the older light green with scabrous spots, the younger smooth, green. Tendrils 2, more commonly 3 cleft. Leaves $2\frac{1}{2}$-5 in. long and about as long as broad, variable usually palmately 3-5 lobed to about the middle (more or less), dark green above, paler beneath, frequently with dark coloured circular gland scattered along the lower side, glabrous, often scabrous with smaller scales above and on the nerves beneath, base cordate; lobes usually ovate oblong, acute, more or less dentate or serrate; petioles 1-3 in. long, striate, puberulous or at length glabrous. *Male flowers*: in axillary 5-10 flowered racemes 6-9 in. long (rarely solitary); pedicles thick, erect, very short; bracts 1 in. long and more, broadly ovate, palegreen, many nerved, fringed dotted with dark green glandular spots. Calyx tube $1\frac{1}{2}$ in. long pubescent, longitudinally striate, teeth lanceolate erect or spreading, laciniate. Petals 1 in. long wedge-shaped, fringed, exceeding the calyx tube. Filaments slightly villous. *Female flowers*: axillary solitary; peduncles less than 1 in. long. Fruit 1·5-2 in. diam., globose red when ripe, strreaked with 10 orange streaks pericarp thick; seeds numerous $\frac{3}{8}$-·5 in. long, ellipsoid, smooth slightly attenuated at the base, not margined.

Habitat

India—very common in all moist thickets, ascending to 5,000 ft., distributed to Ceylon, Malaya, China, Japan, N. Australia. Var. I. *Scotanthus C. B. Clarke*: calyx teeth broad lanceolate entire, petals nearly destitute of fimbriations especially in the females. Var. II. *tomentosa* Heyne in Herb. Rottler; leaves tomentose beneath divided not more than half way down. This variety rather look like a good species but the fruit and seed are as in var. I., and it closely resembles the Australian *T. subvelutina* Muell. in Herb. referred to *T. palmata* by Benthum. The distribution of *T. palmata* is extended to Japan on the faith of two examples collected by Mexmowioz. They belong to the commonest Bengal type *T. pubra* but bear the name *T. japonica* Regal, which in Regal Ind. Sem. 1868, p. 90, is said to have solitary male flowers and has been referred by Benthum and Hooker to the neighbourhood of *T. cucumerina*. A *trichosanthes* collected in Mergui in Griffith No. 759 (No. 2532 Kew Distrib.) has the leaves with short hair beneath otherwise resembles the var. *tomentosa*.

Distribution

Sikkim, East Himalaya and Khasi Hills, alt. 2,000-6,000 ft.; plentiful. Malacca, China, Bhamo and Japan.

Medicinal and other properties

Fruit finely powdered and thoroughly mixed up with coconut oil, is considered a valuable application in cleaning and healing those offensive sores which sometimes takes place inside the ears.*

* Watt's *D. E. P.* 6, (2), 84.

The same preparation is supposed to have beneficial curative properties in ozæna when poured up the nostrils. The root is described by Wight as useful in inflamation of the lungs in cattle. O'Shaughnessy* was induced by the singularly bitter taste of the rind to make experiments with a view to ascertaining whether it possesses purgative, tonic or aperient properties but given in three-grain doses thrice daily it was found to produce no sensible effect (Beng. Dispens). Dymock† states that natives in Bombay sometimes smoke the fruit as a remedy for asthma. The root with an equal proportion of colocynth root is rubbed into a paste and applied to carbuncles ; combined with equal portions of the three myrobalans and turmeric, it affords an infusion which, when flavoured with honey is given in gonorrhœa cases (*Materia Medica West Ind.*). The juice of the fruit or the root bark boiled with gingelly oil, is used with good effect as a bath oil for the relief of long standing or recurrent attacks of headache (Surgeon Major W. R. Thompson, C.I.E., Madras).

The bright-red fruit of the wild plant is non-eatable owing to its severely drastic properties, but, under cultivation the fruit becomes a wholesome vegetable when well-boiled. At the Cape of Good Hope its poisonous properties appeared to be removed by pickling (*J. Agric. Hort. Soc. X, series*, 3).

According to Roxburgh the poisonous fruit is mixed up with rice and is employed to kill crows. It is used by the Hindus of Western India as an ear ornament for the idol Ganpatti, who is dressed up and seated in state in every Hindu house once a year, to bring good luck to the inmates (Dymock).

Occurrences

Assam	Dumpet, vern. Meejuren, Khasia and Jaintia hills, 13 Oct. 1900, Coll. D. Hooper ; Tangali Bam Garden, Joboca Oct. 1898, Coll. Dr. Prain's collector ; Mongsemdi May 1895 collected by the Reporter Economic Products to the Government of India, Jola Bastee near Teock Ghat, Jan. 1899, Dr. Prain's collector ; Shillong, Khasi Hills April 1902, Coll. H. G. Carter ; Haflong, N. Cachar, 2,500 ft. Coll. W. G. Crate ; Khasia, distributed at the Royal Garden, Kew, 1812-3, Griffith ; on the way to Keithemati 3,000 ft., Manipur (on the Eastern Frontier of India) February 4th 1882, Government demarcation Survey of 1881-1882, George Watt ; Sengamoi 3,000 ft. Manipur Coll. George Watt ; Sadiya, Kuwa bhatori, 25th Aug. 1909, Coll. I. H. Burkill.
Burma	S. Shan States Coll. Rev. R. W. MacGregor I.M.S. ; Keng Tung 5,000 ft. ; Shan States, May 1909, Coll. Capt. R. W. MacGregor ; Mogok, Upper Burma, Coll. W. H. Coopert Abdul Hoque, Upper Burma, September 1891, Coll. Abdul Hoque ; Peru Coll. S. Kurz., Madve hill, Upper Burma 20th February 1893, Coll. Dr. King's collector ; Fort Stedman Upper Burma 1893, Abdul Khalil ; Southern Shan States Indin, Upper Burma 1893, Abdul Khalil ; Kachin Hills, Upper Burma ; Dist. Mynela, Yunan Expedition 18th May 1868, Coll. D. J. Anderson ; Maymyo, Upper Burma, July 1858, Coll. Badal Khan ; 40 miles from Mandalay, July 1888, Dr. King's collector, Badal Khan Sujin, Upper Burma Aug. 1891, Coll. Abdul Huk.
Andaman	Narcondam 800 ft. ; Rangachang, S. Andaman, 16 Nov. 1889, Coll. David Prain.
Malay Peninsula	Perak 500-800 ft., July 1886, Coll. Dr. King's Collector ; Batu Togoh, Perak 800 ft., Coll. L. Wray Jr. ; Perak, Coll. Revd. Father Scortechini ; Perak open mixed jungle, July 1883, Coll. Dr. King's collector Ulu Bubong ; Larut Perak-ching 500-800 ft., Sept. 1883, Coll. Dr. King's collector ; Malay Archipelago, 1,700 ft., 1881, Coll. H. O. Forbes ; Java, 5,000 ft., 1862.
Sikkim	Rishap 4,000 ft., Darjeeling, 28th July 1870, Coll. C. B. Clarke ; Rangno valley, Sikkim, 2,500 ft., June 1862, Coll. T. Anderson.
N. W. Himalaya	N. W. Himalaya, Coll. P. W. Mackinnon ; Dauglas Dub, 4,000 ft., Kumaon, August 1913, Coll. N. Gill ; Mussorie range, Coll. G. King ; Dehra Dun, June 1870, Coll. G. King.
Upper Gangetic Plain	Bharaich (Oudh), 22 June 1898, Coll. Kursukh ;
Central India	Ajmere, Ajmer-Merwar, Coll. M. C. Morr ; Guna, Gwalior, Coll. G. King.
Bengal	Royal Botanic Garden, Calcutta, August 1906 ; Agartala 500-600 ft., Tiperah 2nd January 1918, Coll. P. M. Debburman ; Magora, Jessore 30 June 1874, Coll. C. B. Clarke.

* O'Shaughnessy, W. B. (1841). Bengal Dispensatory P. 349
† Dymock (1885). *Veg. Materia Medica*. P. 345

Peninsular India . . . Chodavaram, Rampa country, Godavari, 3 Oct. 1920 Coll. V. Narayanaswami; near Junjugudem, Godavari Dt. 5 Oct. 1920, Coll. V. Narayanaswami; Naduvanthumurhi, Travancore State 25 Aug. 1913, Coll. C. C. Calder and M. S. Ramaswami; Courtallum, Coll. M. Rama Rao; Komattiyeri, Javadi Hills 2,300 ft., S. India 28 Sep. 1916, Coll. C. E. C. Fischer; Mysore and Carnatic, Coll. C. Thomson; Kavalay Cochin 200 ft., Nov. 1910, Coll. A. Meebold; Bailur 3,800 ft., 22 Aug. 1905, Coll. G. S. Fisher; Verur Trav. Dec. 1910, Coll. A. Meebold; Kamalapore, Sept. 1910, Coll. A. Meebold; Perambicolam 3-4,000 ft., Cochin, Nov. 1910, Coll. A. Meebold.

Wall Cat. . . . . Prome Hills, Wall Cat. 1826; Gongachora 20 May 1809.

Bihar . . . . . Singhbhum 9 June, 1903, Coll. H. H. Haines; Jatta Pagoda, Sundriban, Aug. 7, 1902, Coll. D. Prain.

17. ***Trichosanthes Lepiniana*** Cogn. Monogr. Phan. Vol. III, 1888, p. 377; leaves membranous, suborbicular, glabrous on both sides, smooth or slightly prickly and scabrous, broadly palmate 3-5-lobed, lobes broadly ovate or triangular, acute or shortly acuminate, margin sparingly subulate denticulate; tendril 3-4 fid; male racemes few flowered; bracts ovate, subulate-incised; calyx tube from apex to base narrow, dentate elongate, deeply 3-5-lobed; Involucraria Lepiniana Naud., in Hubr. Cat. 1868.

Stem robust, elongate, branched, furrowed, glabrous, smooth. Petiole stout, channeled, glabrous, often finely punctate-scabriculate, 4-6 cm. long. Leaves upper surface bright green lower surface pale green, base 5-nerved, 10-20 cm. long and often almost as broad as long, lobes divergent; indentations between the lobes broad, acute, base almost round 2-3 cm. deep. Tendril stout, elongate, furrowed, glabrous. Flowers dioecious. Common male peduncle robust, furrowed, glabrous, bearing 5-10 flowers at the top, 15-20 cm. long, bracteata at the base; bracts thin membranous, entire, narrowly oblong, base narrow, glabrous or puberulous, 2-3 cm. long. Pedicel erect ascending, thick, 2-5 mm. long; bracts, sparingly puberulous, many nerved, teeth long subulate, 4 cm. long, 2-3 cm. broad. Calyx tube, shortly puberulous, longitudinally channeled, 5-6 cm. long, apex 12-14 mm. broad, teeth erect, 14-16 mm. long, 5 mm. broad, lobes long subulate. Petals obovate 2-3 cm. long, deeply laciniate, lobations long fimbriate, filaments of the stamen thick, 2 mm. long; anther head 13-14 mm. long, 4 mm. thick. Female peduncles 2-4 cm. long, ovary oblong, glabrous. Fruit ovoid, smooth, red, 8 cm. long 6 cm. thick. Seeds black, margin obscure, apex truncate, base narrow, slightly wrinkled, 13-15 mm. long, 6-7 mm. broad, 2·5 mm. thick. Flowers April to June.

Habitat

Pondichery (J. Lepine in Herb. Mus. Par.); in Sikkim (Hook f. et. Thomson n. 14 in herb. Kew. Mus. Par. DC., Francav, Berol, Monac, Vindob., Flor. Ham).

Occurrence

Sikkim . . . . . Kolbong 3,000 ft., 9 June 1862, Coll. T. Anderson; Kurseong 3,000 ft., Darjeeling, 12 June 1870; Wood below Lebong 5,000 ft., 16 April 1857; Sikkim 1-4,000 ft., Coll. J. D. H.

18. ***Trichosanthes anaimlaiensis*** Bedd. in Madras Journ. Sc. (1864), Ser. III, I, 47; ***T. Anamalayana***, Cogn. in DC. Monogr. Phan. 1881 III, p. 328;

Leaves 3-5 lobed, upper surface scabrous, lower pubescent, irregularly deeply serrate; tendrils 2-3 fids; male flowers in racemes, calyx male and female similar but lobes in the female are larger and widely laciniate, stamens 3, rarely 4, floral tube gibbose inserted, anthers jointed; female flowers axillary solitary either with a pair of lanceolata bracts or occasionally racemose, bracteate broadly laciniate with glands. Leaves 10-13 cm. long and as broad. Flowers white, corolla hirsute, fruit globose.

Habitat

In tropical India at Mt. Anaimalai, alt. 1,300 ft.

19. ***Trichosanthes himalensis*** C. B. Clarke in Hook. f. Fl. Brit. Ind. II, 608; *Trichosanthes cordata* Wall Cat. 6686 B; *Cucurbita filifolia* Wall Cat. 6721.

An extensive climber, with slender branching sulcate hairy stems; tendrils 3-fid. Petioles and leaves pubescent and hairy. Leaves about 5 in. diameter, nearly circular in outside, palmately 3-5 lobed, deeply cordate, irregularly serrate, roughish above, villous or pubescent beneath. Male peduncles 3-4 in., bracts ½-¾ in., narrowed to the base, not sheathing, lanceolate, incisoserrate. Calyx tube 1½ in., very narrow, slightly hairy. Fruit 3-4 in., long, long cylindric, tapering at both ends. Seeds turgid, obovoid or drum shaped. Flowers April to September. *var. glabior:* leaves glabrous above, pubescent or scabrous on the nerves beneath. Khasia, 4,000 ft. Sikkim alt. 2,000-5,000 ft., from Yuksum to the plains.

Habitat

Sikkim, alt. 2,000-5,000 ft. from Yoksum to the plains, J. D. Hooker and C. B. Clarke..

Occurrence

Upper Gangetic Plain	Kheri (Oudh), 11-4-98, Coll. Inyat.
Sikkim	Kalimpong 4-5,000 ft., Coll. Thomton Ripley; Mungpoo 3,000 ft., Darjeeling, Coll. C. B. Clarke; Sikkim 2,500 ft., Coll. G. King; Darjeeling 4,000 ft., Sept. 1881 Coll. G. S. Gamble; Pankhabari, Sept. 1875, Coll. G. King.
Assam	Khasia 4,000 ft., Coll. J. D. Hooker & T. Thomson.

20. ***Trichosanthes dicaelospermo*** C. B. Clarke in Hook. f. Fl. Brit. Ind. II, 609; *T. reniformis* Kurz. in J.A.S.B. 1871, **2**, 57

Plant, dioecious.

Stem long twining sulcate, puberulous. Leaves cordate-ovate acute denticulate softly shortly pubescent on both surfaces, 4 by 3½ in. not at all lobed; petiole 1½ in. densely villous. Male peduncles in pairs; bracts minute or 0. Calyx tube 1½ in., narrow pubescent teeth spreading subulate. Fruit globose 1·5 in. in diameter, pubescent with 10 pale vertical bands. Seeds pale grey, embeded in orange pulp 3-celled, the lateral cells empty. According to Clarke this is perhaps Kurz's *reniformis* obtained in Sikkim Himalaya, but is not *T. reniformis* Miq. Fl. Ind. Bat. pt. i, 675, which has obtuse lobes to the leaves and the male spike leafy bracteate.

Flowers June to August.

Habitat

Sikkim 2,000-5,000 ft.; Khasi hills 4,000 ft.

Occurrence

Assam	Khasia 4,000 ft., Coll. J. D. Hooker & T. Thomson
Sikkim	Sikkim 1,800 ft. 2,000 ft. 14-6-1876, Coll. G. King; Sikkim 2-5,000 ft., Coll. J. D. Hooker; Sikkim, Coll. S. Kurz; Kurseong 28-8-57
N. W. Himalaya	Dehra Dun, Coll. G. King

21. ***Trichosanthes dioica*** Roxb. Fl. Ind. iii, 701; Wall Cat. 6692 A.B.D.

Vern. Sanskrit-*Patola, pututika;* Hind.—*Parvar, palval, palwal;* Beng.—*Patal*; Uriya—*Patal;* Pb.—*Palwal, Parmal;* Guj.—*Potala;* Tam.—*Kombu-pudalai;*

Dioecious plant. Stem creeping, running to a great extent, five sided, scabrous. Root perennial. Leaves alternate, petioled, cordate, dentate, scabrous, soft when young 3-4 in. in length. Petioles wooly, variously bent, channeled. Tendrils simple or two cleft. Male flowers axillary solitary or pretty long peduncles. Tube of the corolla very long trumpet like: stamens 3 distinct. Female flowers axillary, solitary short peduncled. Corolla large, with fringe. Fruit 2-3½ in. oblong obtuse on both ends, when ripe smooth and of a deep orange colour, about four inches long and the same in circumference. Seeds ⅜ to ½ in., half ellipsoid, compressed, corrugated on the margins. The unripe fruits and tender tops are much eaten by Indians as well as by Europeans and are reckoned exceedingly wholesome.

Flowers March to October.

Habitat

Throughout the plains of North India from the Punjab to Assam and East Bengal. It is extensively cultivated during the rainy season throughout the above mentioned localities, in the same way as the other gourds.

Medicinal and other uses

The leaves, the fresh juice of the fruit and the root are all used medicinally. The leaves are described as a good light and agreeable bitter tonic. The tender tops are regarded as tonic and febrifuge. The fresh juice of the unripe fruit is often used as a cooling and laxative adjunct to alternative medicines. The root is classified amongst the purgatives by *Susruta*.* In bilious fever a decoction of the leaves and coriander in equal parts is given as a febrifuge and laxative. The juice of the leaf is recommended by some eminent physicians as a remedial application to bald patches†. An alcoholic extract of the unripe fruit is said to be a powerful and safe cathartic. According to Ray Bahadur Kanny Lal De‡ the bulbous part of the root is a hydragogue cathartic, operating in the same way as Elaterium, for which it can be substituted. He describes the plant as a wholesome bitter and useful tonic. Dr. Bowser§ from his personal experience describes it as a febrifuge and tonic. The Hindu physicians of the old school placed much confidence in it in the treatment of leprosy. 'The leaves of patal are bitter and produces tonic properties. They are generally fried with flower paste in ghee and eaten. The fruit is an excellent vegetable, which agrees well with convalescents, even from bowel complaints. It is largely consumed as food. The conserve of the fruit is also a nice food for convalescents and can easily be prepared' (Surgeon R. L. Dutt,). "The root is a drastic purgative useful in dropsy" (Assistant Surgeon S. C. Bhattacharjee, Chanda).

The fruit is oblong green when young and orange or yellow when ripe. Unripe fruit is much esteemed as a vegetable, being considered very wholesome and especially suited for patients recovering from illness. The tender tops are also eaten as a pot herb.

Occurrence

Assam	Teock Ghat, near Tangali Bam. Oct. 1898, Dr. Prain's collector; Khasia, Coll. Griffith; Khasia hills 2-3,000 ft. November 1877; Banks of Kullung, October 1847; Orang jungle, March 1902, Coll. A. C. Chatterjee, Assam, February 1891, Coll. Dr. King's collector; Lowkwa 250, Nowgong 26 March, 1885.
Bengal	Agartala 500-800 ft. Hill Tipperah; 20 October 1915, Coll. P.M. Debbarman; Western Bengal, Coll. S. Kurz; Faridpur Station, 31st July 1868; Botanic Garden, Calcutta.
Bihar	Dalsing Sarai, Darbhanga, August 1900, Dr. Prain's collector, Karagola, Purnea, 28th August 1877, Coll. G. King.
Gangetic Plain	Cultivated, Jaunpur, early part of 1916, Coll. G. O. Allen.
Upper Gangetic Plain	Pilibhit 2-6-98, Inayat; Koemari, Saharanpur, 12th April 1808, April 1881.
N. W. Himalaya	Silla Garo to Chamba, 4-6,000 ft., Chamba State, October 1896, Coll. J. H. Lace, Ladak.
Wall Cat.	Sylhet, Coll. W. Gomez, 6692 C.

22. ***Trichosanthes integrifolia*** Kurz. in Jour. Asiatic Soc. Bengal (1877) xlvi II, 99; *Gymnopetalum integrifolium* Kurz. in flora 1871, 295; *Cucumis integrifolius* Roxb. Fl. Ind. III, 724; Wall. Cat. 6730, *Trichosanthes officinalis* Wall. Cat. 6694.

A twining herb; stem scabrid; tendrils usually simple or 2 fid. Leaves cordate-ovate nearly entire, 2 in. in diameter, very harshly scabrous above, densely villous beneath, margin undulate scarcely denticulate; petiole 1 in. Flowers monoecious all solitary white; male peduncle solitary without bracts 1½ in. female peduncle ½ in. *Male*: calyx-tube elongate, densely brown-villous, teeth 5, lanceolate; corolla divided nearly to the base, lobes obovate, entire, yellow veined, pubescent.

* L. Bhisagratna, K. L. (1905). *Susruta Samhita*, (Eng. Trans.), 400-417
† Dutta, U. C., (1900). *Materia Medica of the Hindus*, 169-313
‡ Dey, K. L. (1896). *Indigenous Drugs of India*, 96
§ Bowser (1893). In Watt's *Dictionary of Economic Products* 6, (4), 83

Female: calyx and corolla as in the male; stigma 3, oblong. Fruit $\frac{5}{8}$-$\frac{3}{4}$ in. diameter, orange red glabrous smooth.

Habitat

Bengal (Roxburgh), Poulong (Irrawady estuary), Wallich.

23. ***Trichosanthes Thwaitesii*** Cogn. in DC. Mong. Phan. iii, 387. Syn. *Trichosanthes integrifolia* Thwaites Enum. Pl. Zeyl. 127, not of Kurz.

An annual, dioecious. Leaves $2\frac{1}{2}$-6 by $1\frac{1}{4}$-2 in. glabrous nerved, elliptic or ovate acuminate less often lanceolate, 3-nerved entire coriaceous base rounded or cordate, petioles 3 in. tendrils simple. Flowers somewhat large solitary. Fruit spherical shortly apiculate, 3 in. diam., red; seeds $\frac{1}{2}$ in. numerous crowded, smooth oblong, oblique, compressed truncate at the hilum, with two indentations at the vertex, testa blackish green.

The species is described in Fl. Br. Ind. as *T. integrifolia* and the author confessed that he did not seen the specimens. There is also no specimen up till now available in the Sibpur Herbarium. It may be a doubtful species.

Habitat

Ceylon, 2,000-4,000 ft., Thwaites.

3. Gymnopetalum

Gymnopetalum, Arn. in Hook, Journ. of Bot. (1841) 3, p. 278; Wight in Ann. and Mag. of nat. Hist. 8, p. 270; Endl. Gen. pl. suppl. 2, p. 77; Meisn. Gen. comment. p. 356; Roem. Syn. fasc. 2, p. 17; Miq. Fl. Ind. Bat. 1, part 1, p. 679 (Oart.); Benth et Hook. Gen. pl. 1, p. 822; Kurz. in Journ. Asiat. Soc. Beng. 40, part 2, p. 57 et v. 46, part 2, p. 99; Clarke in Hook. f. Fl. Brit. Ind. 2, p. 611.—*Tripodanthera* Roem. Syn. (1846) facs. 2, p. 11, 48.—*Scotanthus* Naud. in Ann. sc. nat. ser. (1862) 4, v. 16, p. 172; Benth et Hook. l.c.p. 822.—Bryoniæ, Momordiceæ et Cucumeris spec. auct.

Climbing herbs; tendrils usually simple or 2-fid. Leaves petioled, 5-angled or deeply 5-lobed; flowers white rather large dioecious or occasionally monœcious; male peduncles in mature plants 2 from the axil, the earlier 1—flowered, the later longer racemose, one or other often suppressed; bracts of racemed flowers large, incised or small lanceolate; females 1-flowered usually in separate axils. *Male*: calyx tube long, contracted near the mouth, limb of 5 lanceolate segments; petals 5, not fimbriate on margin; stamens 3; anthers included connate, elongate one 1-celled, two 2-celled; cells complicate. Rudiments of the ovary represented by 1 or 3 small linear processes. *Female*: calyx and corolla as in the male; ovary oblong: style long, stigmas 3, short linear, acute at both ends. Seeds many or few ellipsoid, compressed, margined, nearly smooth. Distrib. Five species are distributed in India, China and Malay Peninsula. Species 7.

Key to the Species

A. Bracts of the male racemes prominent narrowed at the base deeply lacerate at apex . . . . . 1. *G. cochinchinense*
B. Bracts of the male racemes oblong serrate . . . . . 2. *G. quinquelobum*
C. Bracts of the male racemes simple small linear . . . . . 3. *G. Wightii*

1. ***Gymnopetalum cochinchinenses*** Kurz. in Jour. As. Soc. Beng. (1871) xl. II, 57; *Bryonia cochinchinensis*. Lour. Fl. Cochinch, 595; DC. Prodr. III. 305; *Momordica tubiflora* Roxb. Fl. Ind. iii, 711 not of Wallich; *Tripodanthera cochinchinensis* Roem. Synops. ii, 48; *Scotanthus tubiflorus* Naud. in Ann. Sc. Nat. Ser. 4 XVI, 172, t. 3; *Trichosanthes cucumerina* Wall Cat. 6690 E; T. Fatoa Ham. in Wall Cat. 6695; *Bryonia grandis* Wall Cat. 6700 KL.

A slender climber, stem 5-angular, more or less scabrous hairy. Leaves 5-angled or lobed about half way down; 2-3 in. diameter, scabrous on both surfaces; tendrils simple or 2-fid. Bracts to the male racemes prominent narrowed at the base deeply lacerate at the apex. Male recemed peduncle sometimes 6-8 in., usually shorter; bracts $\frac{3}{4}$ in., incise-serrate, lobes often again incised. Calyx

tube $\frac{3}{4}$ in., villous, closed by deflexed hairs within above the stamens. Rudiment of the ovary in the male flower 3. Petals $\frac{1}{2}$ in., ovate entire or somewhat crenate. Fruit 2 by $\frac{3}{4}$ in., orange-red, somewhat scabrous, with 10 longitudinal ribs, pulp greenish, not very succulent. Seeds $\frac{1}{4}$ by $\frac{1}{2}$ and $\frac{1}{20}$ in. thick.

Flowers August to November.

Habitat

Sikkim up to an elevation of 2,000 ft. Assam, Cachar, Bengal, common. Chota Nagpur. Tenasserim. Distributed to Malaya and China.

Occurrence

Bengal	Sibpur, 29-9-21, Coll. P. M. Debburman; Barodi, Dacca 1 Sept. 1871 Coll. C. B. Clarke; Matita, Dacca 31 Aug. 1868, Coll. C. B. Clarke.
Wall Cat.	Rangoon 14 Aug. 1826, 6700 L; Goalpara 29 Aug. 1808 Gongachera 29 May 1809.
Bihar	Singhbhum 1 Oct. 1902— Coll. H. H. Hains.
Sikkim	N. Bengal, Sikkim Terai, between Goreedora and Kuprail in jungle 30-9-68.
Bengal	Agartala, 600-800, Hill Tipperah, 11th Nov. 31st December 1915, Coll. P. M. Debbarman.
Assam	Makum, Abor Expedition, 21-11-1911, Coll. I. H. Burkill; Haflong 2,675 ft. 10 Aug. 1908, N. Cachar Coll. W. G. Craib; Tangali Bam., Jaboca, 3 Aug. 1898, Coll. Dr. Prain's collector; Theria, Khasia 250 ft., 10 Oct. 1886 Coll. C. B. Clarke.
Burma	King Tung, 2,500 ft., S. Shan States, July 1909, Coll. Capt. R. W. McGregor; Arracan, Akyab Coll. S. Kurz; Baptanghar—Coll. Dr. Melelland; Tennasserim, Coll. Helfer; Kachim Hills, Upper Burma, 1897, Shaik Mokim; King Tung 400 ft., S. Shan States, December 1909, Coll. Capt. R. W. McGregor.
Bengal	Kodala Hill, 30 miles from Chittagong, Chittagong hill tract, September 1886, Coll. Dr. King's collector; Chittagong October 1869, Coll. S. Kurz.; Chittagong, November 1898, Coll. Mokim.
Sikkim	Chooyoung, 1901, Dr. Prain's collector; Renchy to Rimchinpong 2-5,000 ft., 1 Nov. 1862, Coll. G. King; Rungeet & Teesta junction November 1875, Coll. G. King.
Peninsula India	Veligonda hills Block B, Nellore Dist., 28th July 1914, Coll. M. S. Ramaswami.
Malay Peninsula	Langkano, Kedah, Sept. 1890, Coll. C. Curtis; Pekan, Pahang, 1891, Coll. H. K. Ring; Perak 400-600 ft., July 1886, Coll. King's collector. Sumatra 12 Aug. 1879; Lampung, Sumatra 12 Aug. 80, Coll. H. O. Forbes;

2. ***Gymnopetalum quinquelobum*** Miq. Fl. Ind. Bat. i. pt. i. 681; *G. heterophyllum* Kurz. in Trimen Journ. Bot. 1875, p. 326; *Scotanthus Porteanus* Naud. in Ann. Sc. Nat. Ser. 5, v. 25.

This species approaches nearer to *G. cochinchinensis*. Leaves suborbicular deeply 5-lobed lobes often 3 fid or subpinnatifid, narrow, subsinuate. Bracts of the male racemes oblong serrate. Kurz's *G. heterophyllum* agrees as described in the present species; it is perhaps a specimen with poorly developed male racemes. Kurz says the flowers is white, and quotes *Bryonia heterophylla* Wall. Cat. 6711, which obscures the whole matter, for that plant is *Bryonia palmata* wall (now *Coccina*) while *B. heterophylla* Wall No. 6704 (and of which there is a solitary sheet) differs altogether from Mr. Kurz's description and is a *Ceraciocarpum*.

Flowers November to April.

Habitat

Burma—Rangoon; Mr. Clellard. Pinang; Portar.

Occurrence

Malay Peninsula	Griffith. Singapore; G. Thomson Distb. Malaya and Borneo, Malacca Hill, 1892.
Java	Bantaun Dec. 1879, Coll. H. O. Forbes; Java Coll. T. Horsfield W. Java 1-3,000 ft.; G. Gantur, Java 1-4,000 ft., 1861, T. Anderson.

Andamans	Mt. Hurriel, Nov. 1889, Coll. David Prain ; Pt. Monat, S. Andaman, Coll. S. Kurz ; Kamorta Nicobar Isls., February 1875, Coll. S. Kurz.
Upper Gan. Plain . . .	Banda N.W.P., Indrayan, Aug. 1902, Coll. Mrs. A. S. Bell ; Kheri (Oudh). 21 Aug. 48, Coll. Inyat
N. W. Himalaya . . .	Dehra Dun 12 Sept. 1870, Coll. G. King :
Burma	Moulmain, 10 Feb. 29 ; Silehmyo, 1 Feb. 68, J. Anderson.

3. ***Gymnopetalum Wightii*** Arn., in Hook J. Bot. iii (1841) 278. *G. zeylanicum* Arn. l.c. ; *Bryonia tubiflora* W. & A. Prodr. 347 ; *Cucurbita umbellata* Wall Cat. 6724.

Leaves 5 angled or lobed, 2 in. in diameter, more or less pubescent on both surfaces, denticulate, lobes acute or obtuse or 0 ; petiole 1 inch. Male racemose, peduncle 2 in. ; flowers crowded, subumbellate ; bracts ¼ in. linear, pedicles often ¼ in. ; peduncles of the female flowers ⅜ in. Calyx tube ½ in., slender with scattered hairs or very pilose, lobes, lobes small. Petals ¼ in. (yellow according to Arnott & Hook., white according to Thwaites). Rudiment of the ovary in the male flower simple. Fruit 1½-in. more or less hairy, not ribbed. Seeds ½ by ½ in. without corogations or angles.

Flowers October to January.

Habitat

South Deccan Peninsula, Wight ; Canara, Hohenacker No. 622. Ceylon, ascending to 5,000 ft., Walker, Gardner, Thwaites.

Occurrence

Peninsular India . . .	Kavelay Cochin, 2,000 ft., Nov. 1910, Coll. A. Meebols ; Karimalai, S. Malabar 4,500 ft., 12 Jan. 1910, Coll. C.E.C. Fischer ; Maliyamaduyam 4,000 ft. 11 Sep. 1905, Coll. C. E. C. Fischer ; Madras.
Ceylon	Central Province, up to an elevation of 5,000 ft., Coll. Thwaites.

4. Biswarea

Biswarea Cong. in Comptes-rend. Soc. Bot. Belg. (1882, xxi), 16 ; *Warea* of C.B. Clarke in J. Linn. Soc., 1876, xv, 127.

Extensively scandent herb, tendrils 2 or 3 fid, long petioled, ovate or deeply 5-lobed. Flowers large, yellow, dioecious ; males frequently with two peduncles from one axil, one early deciduous 1-flowered the other bearing a raceme without bracts ; females solitary or with long peduncles. *Male* : calyx tube cylindric, narrow, then suddenly widened campanulate, subhemispheric, teeth 5 linear ; petals 5, ovate nearly separate, entire ; stamens 3 ; anthers connate, included, one 1-celled, two 2-celled, cells conduplicate. *Female* : Calyx and corolla as in the male ; ovary oblong ; style long with 3 wide stigmatic lobes ; ovules horizontal, many, placentas 3, vertical. Fruit oblong, attenuate at both ends, 3-angular, 6-ribbed, 3-valved, usually to the base. Seeds in each cell about 16, in two rows, horizontal, compressed, ellipsoid, smooth. Differs from *Gymnopetalum* by the large campanulate mouth to the calyx ; by the divided tendrils, and the anthers extend from the tubular portion of the calyx.

Biswarea tonglensis Cong. l.c. *Warea tonglensis* C. B. Clarke in Jour. Linn. Soc. xv 129 ; *Gymnopetalum* sp. No. 6, Herb. Ind. or, H. f. & T.

Stem and peduncle nearly glabrous. Leaves 6-9 by 4-5 in., polymorphous, cordate denticulate, nearly glabrous ovate acute or 5 lobed or cut nearly to the base into narrow segments ; petioles 4 in. Male peduncles 8 in. ; pedicles ½-¾ in. calyx tube 1½-in. pubescent, cylindric portion more than ¾ in. Petals ¾ in. Fruit 4 by 1½-in. included in Herpetospermum by J. Hooker in Gen. Pl. i, 839.

Flowers August to October.

Habitat

Sikkim, Alt. 6-1,000 ft., very common ; h.f.j.d.h. ; Tonglo N., C. B. Clarke.

Occurrence

N. W. Himalaya . . .	Tranda, Coll. Dr. Stoliezka.
Sikkim	Senchal, Coll. S. Kurz ; above Phadonchen 7-1,000 ft. 19 Aug. 1910, Coll. W. W. Smith ; Rungbie 6,000 ft. 21 July 1870 ; Senchal 8,000 ft. Darjeeling 13th June, Coll. C. B. Clarke ; Tangloo 8,500 ft. 8 Oct. 75, Coll. W. Gamble ; Sikkim 8-10,000 ft. Coll. J. D. Hooker ; Tangloo 9,000 ft. Darjeeling 13th Sept. 1875 ; Darjeeling, 8,500 ft., 3rd Sept., 1875, Coll. C. B. Clarke ; Sikkim Coll. G. King.

5. Lagenaria

Lagenaria Ser. in Mem. Soc. Phys. Genev. (1825) iii, 1. 25 t. 2, et in DC., Prodr., **3**, p. 299 ; W. et Arn. Prodr., 1, p. 341 ; Spach. Veg. phan., 6, p. 194 ; Meisn. Gen., p. 127 (91) ; Endl. Gen. p. 938 ; Torr. et Gr. Fl. N. Amer., 1, p. 543 ; Roem. Syn., fasc. 2. p. 13, 60 ; Miq. Fl. Ind. Bat., 1, pars 1, p. 668 ; Naud. in Ann. sc. nat ser. 4, v. **12**, p. 91 ; Harv. et Sond. Fl. Cap., **2**, p. 489 ; Benth. Fl. Austral, 3, p. 315 ; Benth et Hook. Gen., 1, p. 823 ; Hoof. in Oliv. Fl. trop. Afr., 2, p. 529 ; Cogn. in Mart. Fl. Bras., fasc. 78, p. 7 ; Clarke in Hook. f. Fl. Brit. Ind., 2. p. 613.—Cucurbita Tourn. Instit., p. 107 ; Adans. Fam., 2, p. 138.

Large climbing herbs, tendrils 2-fid ; leaves ovate or orbicular, cordate, dentate ; leaf teeth glandular ; petiole long, with 2 glands near its apex. Flowers large, white, solitary, monoecious or dioecious ; males with long and females with short peduncles. Sepals 5, connate in a funnel shaped or subcampanulate tube ; lobes of timb narrow. Petals 5, obovate free. *Male* : stamens 3 ; anthers connate included, one 1-celled, two 2-celled, cells conduplicate. *Female* : carpels 3, connate in an oblong, 1 celled ovary ; ovules many, horizontal, in 3 vertical placentas ; style short, with 2-fid, stigmatic lobes. Fruit a large, thickly coriaceous or almost woody polymorphous berry, usually broader upwards. Seeds numerous, horizontal, smooth, with marginal groove.

Lagenario vulgaris Seringe. im Mem. Soc. Phys. Genev. iii, 1 (1825), 23 ; *L. vittata, hispida* and *idolatrica* Seringe l.c. 299 ; *Cucurbita Lagenaria* Linn. ; Lamk. Ill. t. 795 ; Roxb. Fl. Ind. iii, 718 ; Wall Cat. 6719—Rheede Hort. Mal. viii t. 5.

The Bottle gourd. Vern. Sans. *Alabu* (cultivated form), *kutumbi* (wild form) ; Hind. *Kaddu, alkaddu, golkoddu, lauki, ghia, lauka, lau* (cultivated form), *tumri, titalau* (wild form) ; Beng. *lau* (cultivated form), *tita lau* (wild form) ; Santal. *Kadu ;* Nepal. *Phasi, kondra ;* Pb. *Kaddu, lauki ;* Tam. *Soriai-kai, Shora kai ;* Tel. *Kundanunga ampa-chettu.*

An annual, climber with velvety hairs throughout, tendrils 2-fid, stems stout, 5-angled, leaves up to 6 in., ovate or round, 5-angular or lobed leaf teeth glandular base notched, toothed, stalk long with 2 glands at the apex ; flowers 2-4 in. diam., white, solitary, male and female on the same or different plants, male flowers on stalks 1-6 in. long, female on stalks 1 in. long. Some flowers are apparently with abortive ovary.

Male flowers : Calyx tube ½ in. long, funnel shapped, velvety, teeth 5, narrow, petals 5, 1-2 in. long, hairy on both sides, crumpled ovate with a broad tip, stamens 3, anthers joined, enclosed. *Female flowers* : calyx and corolla as in the male. Style short with 3-fid, stigmatic lobes ; fruit up to 6 ft. in length, round, or bottle shapped, thick, almost woody when ripe, seeds ¾ by ⅜ in., ⅛ in. thick, with a grove parallel to and near the margin, white. Petioles —number of bundles 10, hollow at the base and solid at the end with a vascular strand running through the hollow tubular petiole.

Flowers December to April.

Habitat

Extensively cultivated throughout India and in many parts of Australia, America and China ; sometimes also found in wild state in some parts of India, the Moluccas and Abyssinia.

Medicinal and other uses

The seeds were originally one of the four old Cucurbitaceous seeds of the ancients but pumpkin seeds are now generally substituted for them (Dymock).* They are considered cooling and are

* *Materia Medica West. India* 1855, 2nd Ed. 349

given internally as a remedy for headache. The oil from the seed is externally employed in headache. The pulp of the wild form (tumri) is purgative, sometimes it acts as a strong purgative. Lindley states that certain sailors were poisoned by beer which had been standing in a hollowed bottle gourd, the symptoms produced being similar to those attending cholera. It is said to be largely used by the lower class people in the Punjab, as a purgative for horses. The pulp of the cultivated form is occasionally employed as an adjunct to purgatives, and is also considered cooling, diuretic, antibilious, useful in coughs and as an antidote to certain poisons. It is applied externally as a poultice and as a cooling application to the shaved head in dilirium. The leaves are purgative, and are recommended by Hindu physicians to be taken in the form of decoction for jaundice. The juice of the leaf is given for children's diarrhœa.

The cultivated forms are eaten both by Indians and Europeans. The latter boils the young fruit and take as vegetable marrow. If hanged in a free current of air it will keep well for three or four months, hence it may be used as a vegetable for sea voyages. The young shoots and leaves are also considered good vegetable by the Indians.

Economic use : The dried shell of the fruit of the bottle shaped gourd is used as a bottle for water and by the Nagas for holding their zu or beer. The small wild form tumri is used for making string instruments like sitar and bina. The latter instrument is principally used by snake charmers. In Deccan and other localities, the hollowed-out gourd is used as a float for crossing rivers, four or five being considered sufficient to support a man.

Occurrence

Sikkim	Kalijhora 1,000 ft. 11 Dec. 15, Coll. G. H. Cave ; Great Ranjiet valley, Coll. S. Kurz.
Bengal	Thana Makua, Sibpur, 9th May 1916 ; Agartala 500-800 ft., Hill Tipperah, Coll. P. M. Debbarman.
Peninsular India . . .	Madras ; Sind 27th January 1896 ; Bombay.
Upper Gangetic Plain . .	Banda, U. P. 19th May 1903, Coll. Mrs. A. S. Bell.
N. W. Himalaya . . .	Soa valley 4-5,000 ft., Sept. 1895, Coll. J. H. Lace.
Andamans	Ranga chang, April 1891, Coll. Dr. Prain ; Manpur, S. Andaman 13-12-1892, Coll. Dr. King's collector.
Bihar	Chota Nagpur, 24 Aug. 75, Coll. J. T. Wood.
Assam	Mangaldai, March 1902, Coll. A. C. Chatterjee ; Margherata, February 1902 Coll. A. C. Chatterjee.
Burma	Pegu, Irrawaddy and Sittang valley, Prome, Coll. S. Kurz.
Assam	Kohima in the Naga hills, Manipur 3-6,000 ft., April to August 1892 ; Katcha, February 1875, Coll. S. Kurz.

6. Herpetospermum

Herpetospermum Wall Cat. n. 6761 (1831) Hook f. in Benth. and Hook. Gen. Pl., **1,** p. 834 ; C. B. Clarke in Hook. f. Fl. Brit. Ind., **2,** p. 613 : *Rampinia*, C. B. Clarke in Journ. Linn. Soc. 1876, **15,** p. 129 ; Bryoniæ spec. Auct.

Extensively scandent, tendrils 2-3-fid. Leaves long petioled, cordate, ovate, little lobed. Flowers large, yellow, dioecious ; males frequently with two peduncles from one axil, one early deciduous 1-flowered, the other racemose without bracts females solitary on very short peduncles. *Male* : calyx-tube elongate, cylindric at the base, above narrow funnel shaped ; teeth 1-5, long included, one 1-celled, two 2-celled, cells conduplicate. *Female* : calyx and corolla as in the male ; ovary oblong, 3-celled, style long, with three oblong bifid stigmatic lobes ; ovules pendulous, 4-6 in each cell. Fruit broad-oblong, narrowed at both ends, 3-angular, irregularly sinuate-costate, valves three separating from the axis nearly to be base. Seeds in two rows in each cells, flat, oblong, pendulous, the lower end corrugate or almost 3-lobed.

Herpetospermum caudigerum Wall. Cat. n. 6761 ; *Bryonia pedunculosa* Seringe in DC. Prodr. iii, 306 : *Rampinia herpetospermoides* C. B. Clarke in Journ. Linn. Soc. xv. 130.

Stem and peduncles more or less pubescent. Leaves 3-6 in. long and broad, usually pubescent on both surfaces. Serrate acuminate ; petiole 2-4 in. *Male* peduncle 8 in., pedicles 1 in., hairy. Calyx tube 1 in., pubescent outside. Petals often 1 in. Rudiment of the ovary in the male linear, simple. Fruit 3 by 1½ in., more or less pubescent. Seeds usually 12, sometimes 18. ½ by ¼ and ⅛ in.

thick, often exhibiting when dried wavy marks on the surface, packed in a fibrous almost juiceless pulp. Wallich's Khasi specimen exhibits ripe seeds which are very narrow, incised at the lower end so that the middle lobe appears as a spinous tooth. Lady Dalhousie's collections of specimens at Simla are nearly glabrous with smaller flowers. *Herpetospermum* of Benth. and Hook. f. Gen. Pl. i. 834, described from imperfect materials included *H. caudigerum*, *Warea tonglensis* and *Edgaria darjeelingensis*. The generic character did not fit *Warea* or *Edgaria* and required emendations to the ovules and seeds of Wallich's *Herpetospermum*.

Flowers August to September.

Habitat

Temperate Himalaya, from Simla and Kumaon to Bhotan, alt. 5,000-8,000 ft.; very common in Sikkim, Khasia Mts.; Wallich.

Occurrence

N. W. Himalaya . . .	Alwar to Baira 4-6,000 ft., Chamba State, 30th Sept. 1898, Coll. J. H. Lace; Dehra Dun 1870, G. King; Simla.
Sikkim	Cheung Chang, 6,000 ft., Coll. Ribu and Rhomoo; Garden of Lasha house, Tibet frontier commission 1904, Coll. H. J. Walson; Sinchal 8,000 ft., Darjeeling, 15th Sept. 1875, Coll. C. B. Clarke; Sikkim, S. Kurz; Sikkim, 7-9,000 ft., Coll. J. D. H.; Lachung 9,000 ft., 27 Aug. 92, Coll. G. A. Gammie; Kaljorinie, 10,000 ft., Aug. 1888—Coll. D. Ging's collector; Youmtham 190 Dr. Prain's collector.

7. Luffa

Luffa, Tourn. Act. Acad. Paris, 1706, p. 84, tab. 6; Dill. Nov. Gen. p. 156; tab. 11; Adans. Fam. **2,** p. 138; Cavan. Icon. **1,** p. 7, tab. 9, 10; Vent. Tabl. **3,** p. 513; Willd. Spec. **4,** p. 380; Poir. in Dict. sc. nat. 27, p. 287; Bl. Bijdr. p. 922; Ser. in DC. Prodr. 3, p. 302; W. et Arn. Prodr. 1, p. 343; Roxb. Fl. Ind. **3,** p. 712; Spach, Veg. phan. **6,** p. 217; Meisn. Gen. p. 126; (91); Endl. Gen. p. 937; Arn. in Hook. Journ. of Bot. **3,** p. 277; Wight in Ann. and Mag. Nat. Hist. **8,** p. 269; Roem. Syn. fasc. **2,** p. 14, 63; Miq. Fl. Ind. Bat. 1, part. 1, p. 665; Naud. in Ann. sc. nat. ser. 4, v. 12, p. 118; Harv. et Sond. Fl. Cap. **2,** p. 530; Benth. Fl. Austral., **3,** p. 316; Benth. et Hook. Gen. 1, p. 823; Hook. f. in Oliv. Fl. trop. Afr. **2,** p. 530; Cogn. in Mart. Fl. Bras. fasc. **78,** p. 9; Clarke in Hook. f. Fl. Brit. Ind. 2, p. 614;—Turia Forsk. Fl. Aegpt. Arab. p. 165 (1775); Poir. in Lam. Encycl. meth. Bot. **8,** p. 139, et in Dict. sc. nat. **56,** p. 124; Ser. in DC. Prodr. 3, p. 303, Meisn. Gen. p. 127 (92); —Trevouxia Scop. Introd. p. 152 (1777); Juss. in Dict. sc. nat. **55,** p. 180. Poppya Roem. Syn. fasc. **2,** p. 13, 59 (non Neck).—Momordicæ, Cucurbitæ et Cucumeris sp. auct.

Annual herbs. Tendrils 2-many fid. Leaves 5-7 lobed (rarely subentire) with glands in rows on the lower surface of the leaf especially on both sides of the prominent veins; petiole without glands at the apex. Flowers monœcious (rarely dioecious), rather large, yellow or white, males and females often from the same axil. Male flowers racemose. Calyx tube campanulate or turbinate; lobes 5, triangular or lanceolate. Petals 5 free, spreading, obovate or obcordate. Stamens 3 (rarely 5), inserted on the calyx tube; filaments free or connate; anthers exerted, free, one 1-celled, the others 2-celled, the cells sigmoid, often on the margin of a broad connective. Rudimentary ovary glanduliform or o. Female flowers solitary. Calyx tube produced beyond the ovary; corolla as in the male. Staminodes usually 3, thick. Ovary elongate, sulcate angled or cylindric, 3-placentiferous; ovules numerous, horizontal; style columnar; stigma 3-lobed. Fruit dry, oblong, or cylindric (not spherical), acutely ribbed or terete, smooth or echinate, fibrous in the 3-celled, terminated by the persistent style, usually circumsciss near the apex. Seeds many oblong, compressed.

Species 10, in the tropical regions of the old world one species indigenous in America.

KEY TO THE SPECIES

A. Stamens 5
  B. Male pedicles clustered in the axil . . . . . 1. *L. graveolens*
  BB. Male flowers racemed on long peduncles . . . . . 2. *L. cylindrica*
AA. Stamens 3
  B. fruit angled
    C. Fruit elongate 10 angled, covered by spines or papillae . . . 3. *L. acutangula*
  BB. Fruit not angled
    C. Fruit elliptic, densely covered with bristles, filaments united . . 4. *L. echinata*
    CC. Young fruit spinous, spines densely wooly filaments free . . 5. *L. umbellata*

1. ***Luffa graveolens*** Roxb. Hort. Beng. 70 ; Wall. Cat. 6752 ; Naud in Ann. Sc. Nat. Ser. 4. xii, 124 ; Kurz. in Journ. As. Soc. 1877, pt. ii, 101.

Stems slightly villous, tendrils from three to four cleft. Leaves reniform, somewhat lobed, and always toothed, axillary, punctuate. Scabrous above, pubescent on the nerves beneath : petiole 2-3 in. Male pedicles few, much shorter than the petiole. Petals 5. ¼ in., yellow entire : stamens 5. Female peduncle short, sometimes divided with 2-3 flowers each pedicel carrying a small ovate entire thick bract ⅛ in. Fruit 2 by 1 in., covered with pepillæ. Seeds scarcely ¼ in., very many, packed in fibres, smooth not margined.

Flowers August to September.

Habitat

Sikkim 1,000-2,000 ft. ; J.D.H., Rajmahal hills ; Roxburgh. Plains of East Bengal : C.B. Clarke. Chittagong, Kurz., Distrib. North Australia. A native of the Rajmahal hills, from thence the seeds were brought to Botanic Garden, Calcutta, where the plants blossomed during the rainy season and the seeds ripened about three months afterwards.

Occurrence

Sikkim	Sikkim Terai, N. Bengal, Kuprail, Sept. 1868, Coll. S. Kurz
Bihar	Chota Nagpur 24·875, Coll. J. J. Wood ; Jatta Pagoda, Sundribans, 7th Aug. 1902, Coll. Dr. Prain ;

2. ***Luffa cylindrica*** (Lour) Roem. *Syn. Pepon.* 63 ; Naud. in Ann. Sc. Nat. Ser. 9. xii. p. 119 ; Kurz. in Journ. B. Soc. 1877, pt. ii, 100 ; Sampson in Kew Bull. Ser. 12. 1936, p. 106 : *Luffa aegyptiaca* Mill. Gard. Dict. ed. viii ; DC. Prodr. iii, 303 ; *L. pentendra* Roxb. Fl. Ind. iii. 712 : W. & A. Prodr. 393 ; Wall. Cat. 6751 ; Wight Ic.t. 9999 ; *L. racemosa* Roxb. l.c. 715 ; *L. clarata* Roxb. Hort. Beng. 104, Fl. Ind. iii. 714 ; *L. acutangula* W. & A. l.c. not Roxb. *L. Petola* and *Cattapiciinna* Seringe in DC. l.c. ; *L. Parvala* Wall. Cat. 6758 ; *L. Gosa, hederacea and Satpatia* Wall. Cat. 6753, 6755, 6757 ; *Bryonia cheriophylla* Wall. Cat. 6715 A ; *Momordica Luffa* Linn.

Vern. Hind. *Ghia tarui, purula* ; Beng. *Dhun-dul, dhumdul* ; Assam. *Bhol, bhatkerela, bhatkakrel* ; Nepal. *palo* ; N.W.F. *Ghiya toroi, Ghiya tori* ; Kumaun. *Tarod, ghiya taroi, turai, dhandal* ; Pb. *Ghia tori, ghi turai, ghi gandoli* ; Sind. *Turi, tiasada* ; C.P. *Dilpasand, teldoaka* ; Bomb. *Ghosal, parosi, parula, turi, gousali* ; Gurz. *Turia* ; Tel. *Cuttibera, netibera, nunebira* : Burma. *Thabwot, tha pwot-kna* ; Sing. *Neyang-nuttucolu* ; Sans. *Rajakostrataki ; dirghapatolika* : Arab. *Luff* ; Pers. *Khujar.*

Monœcious, climbing to a considerable height. Stem stout 5-angled, twisted glabrous or slightly pubescent, often scabrous at the angles. Tendrils usually 2-fid. Leaves orbicular reniform in outline, 4-8 in. long, often broader than long, palmately 5 (rarely 7) lobed, the lobes acute or acuminate, lobulate and distantly denticulate, both surfaces finely scabrous, punctate, glabrous except the pubescent nerves beneath, base deeply cordate ; petiole 1-4 in. long, angular, slightly scabrous. Male flowers in axillary 4-20 flowered racemes, usually crowded near the top of the raceme : peduncles 4-6 in. long ; pedicles ¼-½ in. long, pubescent, articulated near the apex, each bearing a small lanceolate glandular bract at, or more commonly, a little above its base ; buds ovoid, pointed. Calyx pubescent, ⅓ in. long ; lobes lanceolate, acute, ½ in. long. Petals spreading, 1 in. long, obovate oblong, yellow with green veins. Stamens 5, distinct. Female flowers solitary, usually from the

same axil as the males; peduncles short. 1-3 in. long. Staminodes usually 5, ovary cylindric or somewhat trigonous, blunt at the end marked with longitudinal lines. Seeds black or grey, $\frac{3}{8}$ by $\frac{1}{4}$ in., much compressed, narrowly winged, smooth or slightly tuberculate.

Flowers August to February.

Habitat

Throughout India very common, often cultivated. Distrib: cultivated throughout the tropics: native country uncertain (Naud.).

Medicinal and other uses

The seeds are said to be emetic and chathartic like those of *Luffa acutangula*. The fruit is edible and is used in curries, etc. The dry fruit, which is filled with an interwoven net work of fibre is used as a skin brush during bath.

Occurrence

Wall. Cat.	Botanic Garden, Calcutta, wild on the river side 17th Nov. 1915, Coll. D. M. Debbarman; Wall. Cat. 6715 B; Wall. Cat. 6755 A; Nathpur 27th Aug. 1810; Prome 1826; Irrawaddy 7th Sept. 1826; Sylhet. Wall. Cat. 6688 F;
Upper Gangetic Plain	Lucknow, 10th Nov. 1891, Co. Dr. Prain.
Sikkim	N. Bengal, Sikkim Terai, between Kuprail and Goredoora, in the jungles;
Bengal	Sibpur, Coll. S. Kurz; Badeea, E. Mymansing, 26th Nov. 1868; Rangamura, 500-850, Old Agartala, Hill Tipperah, Coll. P. M. Debbarman; Chittagong, November 1898, Coll. Mokim.
Assam	Tharia Ghant, Khasia, 28th Sept. 1867; Mont. Khasia 0-4,000 ft., Coll. J. D. H. & T. T.; Dhubri, June 1902, Coll. Sk. Mokim; Sibsagar Assam, May 1886, Coll. G. Manu.
Burma	Yammethin Dist., Kaing Reserve, 22nd January 1909, Nyanngbbin Reserve, Insein 18th Nov. 1935; Salween Dist., January 1912, Coll. A. Meebold; Keng Tung 4,000, S. Shan States, Coll. W. MacGregor; Pegu-yomah 25-1-68, Coll. S. Kurz; Shaimmagah 14th Jan. 1968; Coll. J. Enderson; Moulmein; Minbu September 1902, Sk. Mokim; Peguyomah 25th Jan. 1968, Coll. S. Kurz.
Sikkim	Pankabari 10/68, Coll. S. Kurz; Sikkim Terai, 10-11-57, Coll. T. & T.; Sivoke 28-10-78.
Peninsular India	Sadivaiyal, Bolampatty valley 1,600, Coimbatore District, 25-2-1917, Coll. C. E. C. Fischer; Travancore, December 12-1894; Parambicolam, 3-4,000 ft., Cochin, Nov. 1910, Coll. A. Meebold.
C. India	June 1870.
Andamans	Cape Town, Coll. S. Kurz; S. Andaman, April 1890, Coll. G. King; Kamorta, Nicobar Isls., Coll. S. Kurz.
Malay Peninsula	Kinta River banks, Perak December 1880, Coll. Dr. King's collector; Java.

3. ***Luffa acutangula*** Roxb. Hort. Beng. 70: DC. Prodr. iii. 302, Wall. Cat. 6759; Hook. f. in Oliv. Fl. Trop. Afr. ii. 530. excl. syn: Kurz. in Journ. As. Soc. 1877, pt. ii, 101, excl. many syn; *Cucumis acutangula* Wall. Cat. 6736.

Vern. Hind. *Torai, jinga, turi*: Beng. *Jhinga, jinga*: Uriya. *Jauhi*; Santal. *Paror jhinga*; Nepal. *Ramtoroi*; Mal. (S. P.) *Puichenggah*; Bundel. *Kali taroi, satpattiya*; N.W.F. *Terai, kali taroi, torai, salpatiya, jaginga*; Kumaon. *Toric*: Kangra. *Gherur gundoli*; Pb. *Kali tori, turai, jhinga*; Sind. *Turi*: C.P. *Dorka*; Bomb. *Turin ghisoda*: Dec. *Turai*; Tam. *Pikunkai*; Tel. *Burkai, birkaya*; Kan. *Hirekayi*; Tam. *Pikunkai*; Tel. *Burkai, bira kaya*; Malay. *Djinji*; Burm. *Tha-bwot-kha-wai*; *thapwot*; Sans. *Jhingaka*; Pers. *Khiyar*.

Monœcious, climbing to a considerable height: stems 5-angled, glabrous with sharp angles which are often scabrid. Tendrils usually 3-fid. Leaves orbicular in outline, pale green, 6-8 in. long and broad, palmately 5-7-angled or sublobate, scabrid on both sides, base cordate; nerves and veins prominent beneath; petioles 2-5 in. long, angular, scabrid. Male flowers in axillary 12-20-flowered racemes 4-6 in. long. Calyx pubescent obovate, yellow with green hairy veins. Stamens 3. Male flowers, solitary, in the same axils as the males; peduncles 2-4 in. long, ovary strongly ribbed. Fruit 6-12 in. long clavate-oblong tapering towards the base, very obtuse, smooth, longitudinally ribbed

(almost winged) with 10 sharp angles. Seeds ½ by ¼-⅓ in. ovoid-oblong, much compressed slightly corrugated on the sides, not winged, black. Very closely allied to *L. ægyptiaca* from which it differs in the number of stamens, the strongly ribbed ovary, the fruit and the seeds.

Flowers November to June.

Habitat

Cultivated extensively in North West India, Sikkim, Assam and Eastern Bengal; distributed to Ceylon and Malaya.

Medicinal and other uses

The seeds possess emetic and purgative properties but to a marked less degree than var. *amara*. Dr. Emerson states that the leaves are used locally in splenitis, hæmorrhoids and leprosy. Aitchison writes " the root is used in medicine ".

The juice of the fresh leaves is dropped in to the eyes of children in granular conjunctivities, also to prevent the lids adhering at night from excessive meibomian secretion. (Hon. Surgeon P. Kinsley, Chikakole, Ganjam. Madras).

Oil—The seeds of this species like those of the most other Cucurbitaceous plants yield an oil. It is believed to possess similar properties like the oil obtained from the melon.

The fruit is highly esteemed in India and is much eaten, either in curries or dressed with clarified butter. when half grown it is one of the best indigenous Indian vegetables, and when boiled and dressed with butter, pepper and salt is very palatable.

Occurrence

Wall. Cat.	Gongchora, 18th June 1809; 6736C; Royal Botanic Garden, Calcutta 6759 B;
Central India	Jodhpur, February March 1868; Marwar 1868, Coll. G. King; Guna, Coll. Dr. Barklay.
N. W. Prov.	Dehra Dun, 1870, Coll. G. King; N. W. India, Royle.
Beng.	Sibpur 5/67, Coll. S. Kurz; Bamunpukri 5 Nov. 76; Dacca 15th Sept. 1868, Coll. C. B. Clarke; Agartala 600-800 Hill Tipperah, Coll. P. M. Debbarman
Burma	Pegu, Paddy ridges, Coll. S. Kurz.
Laccadives	Minikoy, Dec. 7th, Coll. H.M.I.M., Investigator.
Peninsular India . . .	Gudur 3 Feb. 1929, Nelore Dist., Coll. K. Churian Jacobs.

Var. Amara Roxb. Fl. Ind. iii, 715 (sp.); Wall. Cat. 6754 A; W. & A. Prodr. 343; Dulz. & Gibs. Bomb. Fl. 102; Naud. in Ann. Sc. Nat. ser. 4, xii, 123; *L. Plukenetiana* ser. in DC. Prodr. iii, 302; *Momordica tubiflora* Wall. Cat. 6749; *L. amara* Roxb. Woodr. in Journ. Bomb. Nat. (1898), v. 11 p. 640.

Vern. Sans. *Koshatakh*; Hind. *Karrituri, karuotarui*; Beng. *Ghosha-lata, tilo-jhinga, tito-toroi, tito dhundul*; Dec. *Kurui turai*; Bomb. *Kodu sirola, kadu dorka*; Mar. *Kadu dodaka*; Tam. *Pepirkkam*; Tel. *Adavi-bira, chedu bira, veri bira.*

Leaves smaller, at first whitish and softly villous, at length scabrid. Flowers smaller. Fruit obovoid, obtusely conical at both ends, 2-4 in. long by about 1-1½ in. thick 10-ribbed, bitter. Seeds smaller.

Habitat

Met with all over India especially on the Western side.

Medicinal use

Roxburgh* first pointed out the medicinal properties of this plant. He remarks.-' Every part of this plant is remarkably bitter the fruit is violently cathartic and emetic. The juice of the roasted young fruit is applied to the temples by natives to cure headache. The seeds either in fusion

* Roxburgh, W. (1820) *Flora Indica* Ed. C.B.C. 24, 699

or raw, are used by them to vomit and purge.' In Pharmacopœia of India the plant is described as bitter, tonic and diuretic but the vernacular names applied to this plant as *Kerula* or *bindal*, it appears to be misrepresented for *Momordica charantia*. Dymock* writes, 'The leaves are bitter the fruit less so; the former in Bombay are used as an external application to sores in cattle. In dog bite the pulp of the fruit is given with water; it causes vomiting and purging. The juice is applied in different kinds of bites, and the dried fruit is used as a snuff in jaundice. The root with equal parts of the root of *Hibiscus rosa-sinensis* (vern. jaba) and *Hemidesmus* (vern. anantamul) is given with milk, cumin and sugar in gonorrhœa. From the following interesting note by Moodeen Sheriff it would appear that the seeds, if carefully prepared and administered, are of considerable value as a specific for dysentery. Should this prove to be correct, the drug would be a cheap, easily obtained and most valuable substitute for Ipecacuanha.

'The mature and dry seeds of both *Luffa acutangula* and *L. amara* are emetics, but the action of former is very irregular and uncertain. In some cases, they act in twenty to thirty-five grain dosses pretty satisfactorily, but in others they either do not act at all or act violently and continue to produce vomiting for many hours. On the other hand the action of the seeds of *L. amara* is very sure, safe and efficient in the same or somewhat smaller doses. The Hindu practitioners are aware that the fruit of *L. amara* is emetic but they do not know what particular part of it possesses that property. They use the seed and all other parts together in fusion. One entire fruit, generally of middle size, is bruised and infused in some cold water at night, and the liquid is strained through and administered in the morning. The action of this draught is generally very irregular, uncertain and often accompanied by gripping and is therefore very unsatisfactory. I have used the different parts of the plant separately and found the emetic property to reside in the kernel or cotyledons of the seeds. The seeds are dark brown, oblong or oval, flat rough with minute elevated dots, margin turned, and only distinct at the base. The length of the seed varies from one-third to half an inch, and the breadth from three to five line; the kernel is albuminous greenish white, very bitter and oily. The kernel of the seed is the best and forms the only vegetable emetic in India which is equal to Ipecacuanha in the same quantity. In smaller doses it is expectorant and also demulent, owing to its containing albumen and oil. In addition to the above properties it has a great control over dysentery. I have used this drug and also Ipecacuanha, separately, in several cases, in same manner and doses, and found it to be at least quite equal to the latter. The dose of the kernel as an emetic is from twenty to thirty grains; as a nauseant, from five to ten grains. When the kernel is rubbed and mixed with water it forms a greenish-white emulsion, which is the only form in which I have yet used it.' (Hon. Surgeon Moodeen Sheriff, Khan Bahadur, Triplicane, Madras.)

Occurrence

Peninsular India . . .	Madras
Assam	Goalpara
C. I.	Marwar Rajputana, Guna, Aug. 1867, Coll. G. King
N. W. Himalaya . . .	Dehra Dun, Sept. 1860, Coll. G. King

4. ***Luffa echinata*** Roxb. Hort. Beng. 104; Roxb. Fl. Ind. iii, 716; Wall. Cat. 6756; W. & A. Prodr. 343; Dalz & Gibs. Bomb. Fl. 102; Kurz. in Journ. As. Soc. 1877, pl. ii, 101. *L. Bindaal.*

Vern. Sind. *Jangthori*; Bomb. *Kukar-wel*; Guj. *Seeds-Wa-upla-bij*; Mar. *Seeds-Deodagri*; Tel. *Pani bera.*

A climber but not extensively; stem slender, branched, furrowed, glabrous. Tendrils 2-fid. Leaves 1½-2½ in. long, usually a little broader than long, reniform suborbicular in outline broadly cordate at the base, obscurely 5-angled or more or less deeply five lobed, lobes rounded or rarely subacute at the apex the margins minutely denticulate; petioles 1-2 in. long, striate, puberulous or sometimes lightly scabrid; flowers usually dioecious. *Male flowers*: peduncles 3-6 in. long, usually in pairs, one 1-flowered, the other with a raceme of 5-12 flowers at the apex; pedicles ⅜-¾ in. long, bracteata near the base calyx hairy, ¼ in. long; tube very short; lobes ovate-lanceolate, acute.

† Dymock, W. (1885) *Materia Medica of Western India* 2nd Ed, 342

Petals white, spreading, obovate twice as long as the calyx, veined. Stamens 3, two with 2-celled anthers. *Female flowers :* peduncles 1-2 in. long. Fruit broadly ellipsoid, 1-1½ by ½-¾ in., not ribbed, clothed with ciliated bristles ⅙-¼ in. long ; operculum conical, without bristles. Seeds numerous ⅛-⅕ by ⅛ in., not winged, slightly verrucose.

Flowers August to December.

Habitat

Gujarat, Dalzell ; Sind, Stocks ; Purneah, Kurz ; Dacca, C.B. Clarke. Distributed to tropical Africa.

Occurrence

Upper Gangetic Plain . .	Bahraich (Oudh) 10-7-98, Coll. Harsukh ; Banda, U. P., Nov. 1901, Mrs. A. S. Bell
Central India	Isagarh Dist. Gwalior 1867, Coll. G. King ; Ajmere, 27 Aug. 1875 ; Guna, Saugar, Chindwara Dist., C. P.
N. W. Himalaya . . .	Swat valley, 3,000 ft., N. W. F. P., 17-9-95, Chitral Relief Expedition, 1895, Coll. Brig. Genl. Gatacre ; Simla 31, Oct. 1864, Coll. Brandis
W. India	Bombay, 1878
Assam	Bonihat, Khasi Hills, 16. June, 1911, Coll. R. K. Das
Wall. Cat.	6756A ; Chandalgar 30 Sept. 1813, 6756 B
Bihar	Dalsing Sorai, Darbhanga, Aug. 1910, Coll. Dr. Prian's collector ; between Dingraghat and Purnea 30-12-68, Coll. S. Kurz

Var. *longistylis* Edgw. in Journal As. Soc. 1852, p. 270 (sp.)

Male raceme shorter than the leaves, spines of the fruit fewer themselves glabrous. Banda, Edgeworth. The leaves are not more dissected than in some Bengal typical *L. echinata*, nor are the styles longer. The whole male raceme is much shorter than the accompanying 1-flowered male peduncles.

Medicinal use

According to O'Shaughnessy* the fruit is considered in North India to be a powerful remedy for dropsy. S. Arjun† remarks that the fruit possess purgative properties. Dymock** writes, " I have not met with any notice of the medicinal use of this plant in European works on the Materia Medica of India." (The writer seems to have not noticed the observation of O'Shaughnessy and Arjun). Roxburgh‡ describes, " In the Bombay Presidency it is found mostly in Gujarat where it has a reputation among the Hindus on account of the bitter properties of the fruit, and is an ingredient in their compound decoction. In the Konkan a few grains of the bitter fibrous contents of the fruit are given in infusion for snake bite, and in cholera after each stool. In fevers the infusion is applied to the whole body, and in jaundice it is applied to the head and also given internally ; the infusion has also a reputation as a remedy for colic. The dried vine with the ripe fruit attached is brought to Bombay for sale along with other herbs from the province of Gujerat."

5. *Luffa umbellata* M. Roem.

Synops. Pepon., ii, 63; L. Kleinii W. & A. Prodr. 344 : *Cucurbita umbellata* Heyne in Herb. Rottler ; Wall. Cat. 6724 ; D.C. Prodr. iii 318.

Young fruit spinous, spines densely wooly. Agrees closely with *L. echinata* and may be a variety of it but the stamens differ : the filaments being three, of which two are bifid below the stamens.

Habitat

Travancore, Klein ; Coromandal (?) Wight.

8. Benincasa

In Bibl. Batal. 9, p. 158 cum icone (1818) ; in D.C. Prodr. 303 ; Spach. Veg. phan. 6, p. 203 ; Meisn. Gen. p. 127 (91) ; Endl. Gen. p. 938 ; Arn. in Hook. Journ. of Bot. 3, p. 277 ; Wight in Ann.

* O'Shaughnessy, W.B. (1841) *Bengal, Dispens*, 346.
† Arjun, S. 1879 *Cat. Bomb. Drugs*, 59.
**Dymock (188 5) *Materia Medica West India*, 343.
‡Roxburgh, W. (820) *Flora Indica*, 24, 699.

and Mag. of Nat. Hist. 8, p. 269 ; Roem. Syn. fasc. 2, p. 14 ; Naud. in Ann. Sc. nat., ser. 4, v. 12, p. 87 ; Benth. et Hook. Gen. 1, p. 824 ; Hook. f. in Oliv. Fl. trop. Afr. 2, p. 532.—Cucurbitæ sp. Auct.

Benincasa, Savi.

A large climber, softly hairy, tendrils 2-fid. Leaves cordate, reniform orbicular, more or less fine lobed ; petiole without glands. Flowers large, yellow, monoecious, all solitary, without bracts. *Male* : calyx tube campanulate, lobes 5, leaf-like, serrate ; petals 5, nearly separate, obovate ; stamens 3, inserted near the mouth of the tube, anthers exerted, free, one 1-celled, two 2-celled, cells sigmoid. *Female* : calyx and corolla as in the male ; ovary, oblong densely hairy ; style thick, with 3 flexuose stigmas ; ovules numberous, horizontal ; placenta 3. Fruit large, fleshy oblong, pubescent, indehiscent. Seeds many, oblong compressed, margined.

***Benincasa hispida* Cogn.** in DC. Mon. Phan 1881 iii, 513 ; Wall Cat. 6723 ; Sampson, Kew Bull. Ser. 12, 1936, p. 20. *Benincasa cerifera* Savi.l.c.; W. & A. Prodr. 344 ; Miq. Fl. Ind. Bot. i. pt. i, 665 ; Naud. in Ann. Sc. Nat. Ser. 4, xii, 87 ; Kurz. in Jour. As. Soc. 1877, pt. ii, 101 ; *Cucurbita pepo Lour.* Fl. Cochin. 593 ; Roxb. Fl. Ind. iii, 718 ; *C. farinosa* Blume Bijd.; *Gymnopetalum calyculatum* Miq. Fl. Ind. Bat. suppl. 332.

The white gouard Melon.Vern. : Sans. *Kushamanda, Kuspandaha ;* Beng. *Chalkumra* ; Pb. *Petha, chalkumra, gol kaddu ;* Hind. *Gol Kadu, kudmiah, Kondhza, Kumrha, petha, phuthia ;* Kumaon *Kumhra, churja* ; Mar. *Kohala ;* Cutch. *Kushmand, Kohula ;* Guj. *Bhura kola, Kholu ;* Bomb. *Kohala, Koholen, goldaku* ; Sing. *Golkadu* ; Tam. *Kaliyana-pushinik-kay* ; Tel. *Burda gumudu, brididi gunuandi, pendli gummadi-kaya* ; Mal. *Kumpalanna, Kumpalama Kam Binde-kumbala-kayi ;* Burma Kyank-payon.

Annual, softly hairy, stem stout, angular, tendrils 2-fid, leaves 4-6 in. diam., kidney-shaped, round, base notched, more or less deeply 5-lobed, stalks 3-4 in. without glands ; flowers large, yellow, solitary, without bracts. Monœcious, male flowers on stalks 3-4 in., calyx tube bell-shaped, lobes 5, leaf like, toothed, corolla 5-lobed, ovate almost to the base, stamens three, almost on the mouth of the tube, anthers free, protruding. Female flowers, calyx and corolla as in the male style thick, with 3 zigzag stamens (syngenesious) ; fruit 12-18 in. long, oblong, fleshy, with a waxy bloom, seeds many oblong, flattened.

Habitat

Cultivated throughout India. Distributed through cultivation in Malaya, China, Japan ; tropical Africa ; no record of occurrence in wild state anywhere ; according to DeCandolle it is a native of Japan and Java.

Affinity. Morphologically *Benincasa* resembles *Cucurbita* hence these groups may be placed side by side. From the anatomical stand point however *Benincasa* differs much from *Cucurbita* as the number of vascular bundles in the former, in the mid rib of the leaf is four and all arranged in a straight line while in the latter the bundles are seven in number all arranged in an ellipse, the largest of them being placed at the base. This difference in the number of vascular bundles are antagonistically speaking of their phylogenetic relationships. But from the phytogenetic stand point of the reduction of vascular bundles due to evolution, if we consider the side bundles of the midribs of *Cucurbita* are united, we at once arrived at an arrangement found in *Benincasa. Benincasa* is nowhere found in wild state in the world which gives further evidence of its highly evolved stage. Moreover Blume, Loureino and Wallich placed *Benincasa* as a species of *Cucurbita.* Watts writes, " This plant is so like the pumpkin that the earlier botanists took it for *Cucurbita.* To distinguish it from *Cucurbita pepo* DC., the following characters may be useful.—Stem and leaves softly hairy. Male flowers large solitary ; petals 5, nearly free ; stamens 3, inserted near the mouth of the tube anthers free exerted. Fruit 1 to 1½ ft., cylindric, ribs, hairy when young and bright green, ultimately becoming smooth and covered with bluish white waxy bloom ; pulp flesh white." Flowers April to November.

Medicinal and other uses

The fruit possesses alterative and styptic properties and is popularly known as a valuable anti-mercurial. It is also said to be cooling. It is considered tonic nutritive and diuretic and a specific for hæmoptysis and other hæmorrhages from internal organs. For this purpose the fresh juice from the fruit is administered, while a slice of the fruit is at the same time applied at the temples. According to the Sanskrit authors, it is useful in insanity, epilepsy, and other nervous diseases : the fresh juice is given either with sugar or an adjunct to other medicines for this disease.

" It would appear that the older Sanskrit writers were not acquainted with its peculiar action on the circulatory system by which it rapidly puts a check to hæmorrhage from the lungs. The Raja Nirghantu, the oldest work on therapeutics, gives a long account of its virtues, but does not allude to its uses in phthisis or hæmoptysis. Neither does *Susruta* mention it in his chapters on the treatment of hæmorrhage and phthisis, though the plant is alluded to by him elsewhere. The more recent compilations such as. *Chakradatta*, *Ayurveda Sangraha*, *Sarangadhara*, etc. gives numerous preparations of the article and detail of its uses." " In preparing this medicine " in the form of confection " old ripe gourds are selected. Those not at least a year old are not approved. They are longitudinally divided into two halves and the pulp scraped out in thin flakes by an iron comb or scratcher. The watery juice that oozes out abundantly during this process is preserved, the seeds being rejected. The pulp is boiled in the above mentioned juice, till soft. It is then tied up tightly in a cloth and the fluid portion allowed to strain through it. The softened and drained pulp is dried in the sun and the watery portion is preserved for future use. Fifty tolas of the prepared pulp are fried in sixteen tolas of clarified butter, and again boiled in the juice of the fruit, till reduced to the consistence of honey. To this are added fifty tolas of refined sugar, and the whole is heated over fire, till the mass assumes such a consistence as to adhere to the ladle." The pot is then removed from the fire and a number of flavouring demulunt added, such as peeper, ginger, cumin, cardamons, cinnamon etc., the mixture being stirred until cold. Dose from 1 to 2 tolas according to the age and strength of the patient is prescribed. The seeds possesses anthelmintic properties and are useful in cases of tænia. The expressed oil of the seeds, in doses of half an ounce, repeated once or twice at an interval of two hours, and followed by an aperient, is said to be equally efficacious.

" The fresh juice is often used as a vehicle to administer pearl shell for the cure of phthisis in the first stage " (Asst. Surgeon S. Arjun, Bombay). " It is considered a specific in pulmonary consumptions. A country preparation made of the ripe fruit called *Kushandakhanda* is considered very efficacious in phthisis pulmonalis and I have seen people benefitted by it " (Surgeon K.D. Ghosh, Bankura). " This is so universally believed to be useful in pulmonary consumption that some trails should be made in order to discover whether it has any effect on the bacillus of phthisis. I have seen it produce a decided effect in arresting pulmonary tuberculosis " (Dr. Ghose, Khulna). " Preserve is given in piles and in dyspepsia as an antibilious food " (Surgeon Major W. Moir, Meerut). " This forms one of the chief ingredients of the vapour bath used in Syphilitic eruptions " (Asst. Surgeon A. C. Mukherjee, Noakhali). " The expressed juice of the mature fruit possess purgative and alterative properties. It is used in cases where the system has been effected by mercury " (Brigade Surgeon F. H. Thornton, Monghyr). " The preserve of the white lemon is an easily digestible and highly nutritious food in wasting diseases, as consumption " (Surgeon Major R. C. Dutta, Pubna). " Much used in diabetes with successful results, the juice of the cortical portion (4 oz.), combined with 100 grains of each of powdered saffron and bran of red rice, given morning and evening, with strict diet " (Surgeon E. W. Savinge, Rajamundry, Godavari Dist.). The most common way in which the juice is used is in the shape of a confection with sugar, etc., as a cooling and fattening medicine " (Native Surgeon R. Moodelliar, Chingleput, Madras Presidency). " Useful in piles given with *surun*. Antidote to mercurial poisoning administered in the form of *pak* " (Surgeon W. Barren, Bhuj, Cutch).

The fruit of this plant excretes upon its surface a waxy substance which resembles the bloom found on plums and cucumbers. This is said to be produced in sufficient quantity to be collected and made into candles. The seeds also yield a mild, pale coloured oil.

It is often used in Indian cookery as a vegetable and as a curry. This fruit is also very often used in making sweetmeat, which consists of pieces of this gourd coated with sugar ; this is said to have cooling properties.

Occurrence

Sikkim	Labdah 2,500 ft., 30-7-13 ; Labdah, Coll. C. G. Cave ; Sukna 1,000 ft., 10-9-13 Coll. G. H. Cave
Assam	Danika river, Mahkotea, 4th April, 1895, Collected by the Reporter of the Economic Products to the Government of India ; Alipur, 24 February, 1809
Andamans	Aberdeen 15-11-1889, Coll. David Prain
Bengal	Agartala 800—1,000 ft., Hill Tipperah, 29-9-14, Coll. P. M. Debbarman ; R. B.G., Calcutta
Bihar	Cult., S. Kurz
Burma	Upper Burma, Shan 25. July 1893, Coll. Dr. King's collector
Punjab	1878, Dr. E. Sanders
Upper Gangetic Plain	Cultivated 14th May, 1901, Mrs. A. S. Bell

9. Momordica

Momordica Tourn. Instit. p. 103, tab. 29, 30 ; Linn. Gen. ed. 1, p. 296, edit. 6, p. 506 ; Juss. Gen. p. 395 ; Willd Spec. 4, p. 601 ; Ser. in D.C. Prodr. 3, p. 311 ; Spach, Veg. phan. 6, p. 219 ; Meisn. Gen. p. 127 (91) ; Endl. Gen. n. 5133 ; Roem. Syn. fasc. 2, p. 13 ; Miq. Fl. Ind. Bat., 1, part. 1, p. 663 ; Naud. in Ann. sc. nat., ser. 4, v. 12, p. 129 ; Sond. in Harv. et Sond. Fl. Cap., 2, p. 491 ; Benth. Fl. Austral., 3, p. 318 ; Benth. et Hook. Gen. 1, p. 825 ; Hook. f. in Oliv. Fl. trop. Afr., 2, p. 534 ; Boiss., Fl. Orient., 2. p. 757 ; Cogn. in Mart. Fl. Bras. fasc. 78, p. 13 ; Clarke in Hook. f. Fl. Brit. Ind. 2, p. 616.

Climbing annual or perennial herbs. Leaves entire, lobed or pedately 3-7 foliate. Tendrils simple or bifid. Flowers yellow or white, monœcious or diœcious. Male flowers corymbose or racemose. Calyx-tube short, campanulate, closed at the bottom with 2-3 incurved oblong scales ; lobes 5, corolla usually 5-partite to the base or nearly so, rotate, or broadly campanulate, segments ovate, cordate, stamens 3 (2 in *M. cymbalaria*), inserted on the mouth of the calyx tube ; filaments *short*, free ; anthers at first cohering, at length free, one 1-celled, the others 2-celled, the cells flexuose (rarely short and straight or curved), connective not produced at the apex. Rudimentary ovule 0 or glanduliform. Female flowers solitary. Calyx and corolla as in the male. Rudimentary stamens 0, or 3 glands surrounding the base of the style. Ovary oblong or fusiform, 3-placentiferous ; ovules many, horizontal ; styles slender ; stigmas 3. Fruit oblong, fusiform or cylindric, baccate, indehiscent or 3-valvate, few or many seeded. Seeds tumid or flattened, smooth or variously sculptured. Species 25.

Distrib. Chiefly African a few scattered through the both hemispheres.

The occurrence of cystoliths of calcium carbonate in the epidermal cells of the under surface of the leaf is a remarkable characteristic of the genus *Momordica*. These cystoliths are aggregated from single to as many as eight groups. Calcium oxalate in the form of crystals are also abundantly met with in the stem and root of this genus.

Key to the species

A. Male peduncles 1-flowered
  B. Flowers monœcious
    C. Bracts of male flowers about the middle or below the middle of the peduncle ; cystoliths regular . . . . . 1. *M. charantia*
    CC. Bracts of the male flowers at the apex of the peduncle . . . 2. *M. Balsamina*
  BB. Flower diœcious
    C. Petioles without glands
      D. Leaves smaller, peduncles longer than the petiole, sepals linear, lanceolate . . . . . 3. *M. dioica*
      DD. Leaves large, peduncles shorter than the petiole, sepals oblong . 4. *M. macrophylla*
    CC. Petioles glandular, cystoliths irregular . . . . . 5. *M. cochinchinensis*
AA. Male peduncle several flowered
    C. Flowers monœcious, leaves ovate lanceolate . . . . . 6. *M. denudata*
    CC. Flowers diœcious leaves reniform orbicular . . . . 7. *M. Cymbalaria*

1. ***Momordica Charantia*** Linn. Sp. Pl. 1009; Roxb. Fl. Ind. iii, 707; W. & A. Prodr. 348; Bot. Mag. t. 2455; Miq. Fl. Ind. Bat. i. pt. i. 663; Wight Ic.t. 504; Dalz. & Gibs. Bomb Fl. 102; Naud. in Ann. Sc. Nat. Ser. 9, xii, 131; Kurz. in Journ. As. Soc. 1877, pt. ii, 102; *M. humilis* Wall. Cat. 6747; *M. muricata* DC. 1. c.; *M. senegalensis* Lamk., Encyc IV, 239; *Cucumis africanas* Bot. Reg. t. 980.

Vern. Sans. *Sushavi, karavallilata, karavella;* Hind. *Karela, karali, karola*; Beng. *Karala, uchchhe*; Uriya *Karena*; Assam. *Kakrel, kakiral;* N. W. P. *Karela, karola;* Kumaon. *Kurela*; Pb. *Karela, karila*; Sind *Karelo*; C.P. *Karli*; Bomb. *Karla;* Mar. *Karli, karala*; Guj. *Karela, kareto, karelu*; Dec. *Karela*; Tam. *Pavkka-chedi, pava kai*; Tel. *Kakara, ura kakara, tella kakara, metta kakara*; Kan. *Kagala-kayi*; Malay *Kaipa valli*; *pavakka chati, panti-pavel, kappakka;* Burm. *Ka-hin-ga-bin, kyet-hen-kha*; Sing. *Karawita, battu-karawilla.*

Annual; stem 3-6 ft. long, much branched, angled and grooved, more or less pubescent or hairy; young parts hairy or villous. Tendrils simple, slender, elongate, pubescent. Leaves almost orbicular in outline 2-5 in. on diam., pubescent or subglabrous on both sides, cordate at the base, deeply divided into 5-7-lobes, the lobes acute or subacute, apiculate, coarsely spinous—dentate, constricted at the base, the sinus between them narrow, rounded; petiole 1-2 in. long, channelled, pubescent. Flowers monœcious. *Male flowers:* solitary; peduncles 2-4 in. long, bract at or below the middle. Calyx $\frac{1}{3}$-$\frac{3}{8}$ in. long, pubescent; lobes $\frac{1}{5}$-$\frac{1}{4}$ in. long, elliptic, subacute. Corolla somewhat irregular, lemon yellow, segments obtuse or emerginate, $\frac{2}{3}$-$\frac{3}{4}$ in. long, veined. *Female flowers*: peduncles 2-4 in. long, slender, bracteate usually at or near the base. Staminodes 3, glanduliform. Ovary fusiform, muricate, stigmas 3, bifid. Fruit bright orange coloured, when ripe green when young, 2-6 in. long, pendulous, fusiform, usually pointed or beaked, ribbed, and bearing numerous triangular tubercles giving it the appearance of a crocodile's back (Grahm), 3-valved at the apex when mature. Seeds $\frac{1}{3}$-$\frac{1}{2}$ in. long, compressed, corrugate on the margin, sculptured on both faces.

Flowers September to January.

There are two extensively cultivated varieties in India, differing in the form of the fruit, the one being longer and more oblong and the other smaller more acute, muricated and tubercled placed under var. *muricata* W. & A. These varieties go by the name of *Karala* and *uchhya* in Bengal.

Var. muricata W. & A. Beng. *Uchheye*	Var. proper Beng. *Karala*
(1) Leaves faintly nerved	(1) Leaves prominently nerved.
(2) Peduncles with a round or reniform bract near the base	(2) Peduncle with a round or reniform bract at or below the middle of the base
(3) Fruit small, acute at ends lengthened, tuberculed, tapering at both ends	(3) Fruit large, oblong, gibbous, muricated, with tubercles between, tapering at both ends.

Habitat

Throughout India, cultivated. Distrib. Malaya, China, tropical Africa.

On the lower surface of the leaf of *Momordica charantia* innumerable groups of cystoliths of the calcium carbonate are found. These cystoliths are encased in the enlarged lower epidermal cells. They are generally arranged in double groups or some times in groups as many as seven.[1]

Medicinal and other uses

The fruit is considered tonic, stomachic and cooling and is used in rheumatism, gout and diseases of the spleen and liver. Rumphius[2] states that it was much esteemed in Amboina, where it was supposed to purify the blood, and to dissipate melancholy and gross humours. The fruit and leaves are both administered internally in leprosy, piles, jaundice, and as an anthelmintic. The latter are said by Rumphius to be used by Indian obstetricians to purify the blood and generate milk in the puerperal condition. He states also that a leaf was placed in the mouth of the newly born infant to clear its breast and intestine of all mucus, excrement, etc. Dymock[3] reports that in Konkan a third of a seer of the leaf juice is given in bilious affections as an emetic and purgatives, alone or combined

[1] Chakravarty (1937). *Philipp J. Sc.* 63,409
[2] Rumphius (1741) *Herbarium Amboinense* 5, t. 151
[3] Dymock. W. (1885). *Materia Medica, West India* 340

with aromatics ; it is also applied externally for burning of the soles on the feet, and round the orbit as a cure for night blindness. The fruit of the cultivated form is said to act as a febrifuge. The root is also used medicinally being considered astringent and warm ; and in the Punjab is, according to Honigberger (ex D.E.P.) applied externally to piles. The whole plant combined with cinnamon, long pepper, rice, and the oil of *Hydnocarpus Wightiana* Bl., is employed by the Hindus as an external application in scabris and other cutaneous diseases.

" A case of death from violent vomitting and purging caused by the administration of this juice to a child has fallen in my practice " (Asst. Surgeon, S. Arjun, Bombay). " The fruit is used as a vegetable, cooked as curry. It is bitter and possesses wild laxative, antibilious and tonic properties " (Civil Surgeon D. Basu, Faridpur, Bengal). " The expressed juice with chalk is used in apthæ, and is also as an emmenogogue in dysmenorrhœa. It is applied externally to the scalp in pastular eruptions " (Surgeon Major D. R. Thomson., Madras). " Useful as an application to burns, and allays the irritation of boils. Commonly prescribed as an anthelmintic, and as a purgative for children " (Civil Surgeon, J. Mc-Conaghey Shajahanpore). " The fruit is anthelmintic " (U.Ummegudien).

The young fruit is highly esteemed as a vegetable in Indian cookery. The fruit of the variety *muricata* though much smaller is more esteemed. This is found in abundance in every market. Treatment in hot water and salt is necessary previous to cooking or frying to take away a portion of the bitterness.

Occurrence

Peninsular India	Rampha chodavaram, Travancore State, Sept. 1920, Coll. V. Narayanaswami ; Kalla, 1-9-1913, Coll. C. C. Calder and M. S. Ramaswami ; Quilon, Travancore, 11-11-13, Coll. R. Rama Rao ; Karianshola, Anamalai Hills 2,400 ft., 1-10-1912 Coll. G. Thomson ; Kolathur, Coimbatore, 17-1-06, Coll. C. E. C. Fischer, Madras ; Cuddupah 500 ft., July 1885, Coll. G. S. Gamble ; Bombay, Adyar Jan. 1876
Wall. Cat.	Royal Botanic Garden, Calcutta ; Patna 16. April 1812, 6765 B ; Catiram 3 March 1808, 6745 B ; Kaliganj, 26 February 1809
Bengal	Old Agartala 500-800 ft., Hill Tipperah, 31-12-14, Coll. P. M. Debbarman ; Chittagong, November 1890, Coll. Mokim ; R.B. G., Calcutta ;
Rajputana	Marwar, 1868, Coll. G. King
N. W. Himalaya	Baddi outer Himalaya, Coll. Dr. Brandis ; N. W. India ; near Mussoorie, 3. Oct. 1870, Coll. Dr. King
Upper Gangetic Plain	Lucknow, May 1854
Bihar	Chota Nagpur, 9 January, 1878, Coll. J. J. Wood
Assam	Kamrup plains, Sibsagar ; November, Coll. Dr. King's collector, Gawhati, August, 1860 ; Mangalai March 1902, Coll. A. C. Chatterjee
Sikkim	Teesta 12-8-14, Coll. C. H. Cave ; below Sureil Aug. 20, 19th Coll. G. H. Carter ; Little Ranjiet valley 2,500 Coll. S. Kurz ; October 1868, Coll. S. Kurz
Burma	Cultivated on the Island opposite Minbu town 8th March, 1703, Coll. Aubert and Gage ; Pegu Yomah, Coll. S. Kurz
Laccadives Isls	Minikoy, Coll. H. M. I. M. Investigator 1891, 6th December.

2. ***Momordica Balsamina*** Linn. sp. Pl. 1009 ; Miq. Fl. Ind. Bat. i. pt. i, 664 ; Boiss, Fl. Orient, ii, 757, excl, syn. Wight ; Hook. f. in Oliv. Fl. Trop. Afr. ii, 537, not of Wallich, nor of W. & A. Prodr. 349 ; Woodr. in Journ. Bomb. Nat. ii (1898) p. 640 ; Aitch, Pb. & Sind. Pl. p. 63 ; Hook. Fl. B.I. **2**, p. 617 ; Watt. Dict. Econ. Prod., **5**. p. 256.

Vern. Sind *Kurelo-jangro* ; C. P. *Mokha* ; Arab. *Mokah*.

Monoecious ; stem 2-5 ft. long, very slender, branched, grooved subglabrous, orbicular in outline, 1½-3 in. in diam., cordate at the base with a broad sinus, palmately 3-5-lobed to about the middle, the lobes rhomboid deeply lobulate, acute and mucronate at the apex, usually constricted at the base, the sinus between the lobes broad and rounded ; petioles ½-1¼ in. long, striate, pubescent. *Male flowers* : peduncles 1-flowered, slightly pubescent at the apex, otherwise glabrous or nearly so, slender, 1-3 in. long ; bract towards the apex of the peduncle, ¼-⅜ in. wide, cordate, orbicular denticulate, variegated green and white, reticulately veined. Calyx ⅜ in. long, pubescent ; lobes in. long 5-7-nerved, triangular, acute, with a long slender mucro. Corolla subregular, yellowish with a dark base ½ in. long obovate, subobtuse, reticulately veined, sometimes apiculate. Anther cells

flexuous, the connective broad. *Female flowers* : peduncles $\frac{1}{5}$-$\frac{1}{2}$ in. long, usually ebracteate or bracteate at the base. Calyx tube linear lanceolate, ovary fusiform, beaked, verucose. Fruit 1-3 in. long, ovoid narrowed to both ends, rostrate, smooth or muricate. Seeds ash coloured, ellipsoid, compressed, $\frac{3}{8}$ by $\frac{1}{4}$ by $\frac{1}{10}$ in., regulose on the flat faces and with a grooved margin which is tuberculate on the edges.

Flowers February to March.

Habitat

Punjab T. Thomson, Edgeworth ; North-west India ; Royle ; Sind ; Stocks. Distributed to Malaya, Australia, Western Asia, Africa to the Cape.

Medicinal use

According to Atkinson*, it is occasionally employed in native medicine. Ainslie† writes "The fruit, Hasselquist informs us in his *Iter Palestinum*, is famous in Syria for curing wounds ; it is a fleshy ovate berry, ending in acute points. The natives cut it open and infuse it in sweet oil, which they expose to the sun for some days, until it becomes red, and then preserve it for use ; dropped on cotton, and applied to fresh wounds they consider it as a vulnerary, little inferior to the balsam of Mecca."

Food—The young fruit is eaten as a pickle ; when ripe it is 1 to 3 inches long, rostrate and orange-red, and is eaten as a vegetable in stews, etc.

Occurrence

Rajputana	Marwar, March 1868, Coll. G. King
W. India	Sind

3. ***Momordica dioica*** Roxb. ex Willd. Sp. Pl. iv. 605 ; DC. Prodr. iii. 312 ; W. &. A. Prodr. 348 ; Wight Ic. tt. 505, 506 ; Jacq. Voy. Bot. t. 71 ; Dalz. & Gibs. Bomb. Fl. 102 ; Naud. in Ann. Sc. Nat. Ser, 4, 4, xii, 133 ; Thwaites Enum. 126, as to a var. a.; Kurz, in Journ. As. Soc. 1877, pt. ii, 102 ; *M. Balsamina* Wall. Cat. 674, IA, B ; W. & A. Prodr. 349, not of others ; *M. Wallichii* Roem. Synop. 58 ; Miq. Fl. Ind. Bat. i. pt. i. 664 ; *M. renigera*, *Hamiltoniana* and *Heyneana* Wall. Cat. 6743, 6744, 6748 ; *M. Missionis* Wall. Cat. 6739 ; Dennst in Miq. l.c. *M. subacutangula*, Blume ex Kurz. Journ. As. Soc. 1877, pt. ii, 102 ; *Trichosanthes Russeliana* Wall. Cat. 6696 L ; Hook. Fl. B. I. 2, p. 617 ; Watt. Dict. Econ. Prod., 5, p. 258.

Vern. Sans. *Vahisi* ; Santal *Kanchan arak* (leaf), *karla* (fruit) : Assam *Bat karila* : N. W. P. *Gol kandra, gol-kankra, ghosalphal* : Pb. *Dhar karela, kirara* : C. P. *Kalwal* ; Bomb. *Kurtoli, kartola, karantoli, vantha-karatola* ; Mar. *Kartoli* : Guz. *Kuntola, kantolan* : Dec. *Kurtoli* : Tam. *Palupaghal-kalang* ; Tel. *Puagakara, agakara* ; Kan. *Gidnagula* : Malay. *Erimapasel* : Burm. *Sapyit, sabyet*.

Dioecious, perennial, with tuberous roots ; stem, slender, branched furrowed, glabrous and shining. Tendrils simple, elongate, striate, glabrous. Leaves membranous, broadly ovate in outline, variable, 1$\frac{1}{2}$-4 by 1$\frac{1}{4}$-3$\frac{3}{4}$ in., cordate at the base glabrous, minutely punctate entire more or less deeply 3-5-lobed, the lobes triangular, ovate or oblong, distantly denticulate ; petioles $\frac{1}{2}$-1$\frac{3}{4}$ in. long, channelled above, pubescent, eglandular. *Male flowers* : peduncle solitary, 1-flowered 1$\frac{1}{2}$-5 in. long, slender, angled, usually pubescent near the top, otherwise glabrous ; bracts cucullate, inserted a little between the flower and inclosing it, orbicular-reniform, $\frac{1}{2}$-$\frac{3}{4}$ in. broad, usually pubescent on both sides, strongly nerved, often ciliolate. Calyx-lobes distant $\frac{1}{3}$-$\frac{1}{2}$ in. long linear lanceolate. *Female flowers* : peduncles nearly as long as those of the male, usually with a small bract near the base. Ovary clothed with long soft papillæ. Fruit 1-2$\frac{1}{2}$ in. long, ellipsoid, shortly beaked, densely echinate with soft spines. Seeds many, $\frac{3}{8}$ in., broadly ellipsoid, slightly compressed, slightly and irregularly corrugated, enclosed in red pulp.

Flowers June to August.

* Atkinson, E. T. (1881). *Econ. Products N-W Provinces*, 7

† Ainslie, W. (1826). *Materia Medica* 2, 275

Habitat

Throughout India, from the Himalaya to Ceylon and Singapore, ascending to 5,000 ft. on the hills. Distrib. Malaya.

Medicinal use

The mucilaginous tuber is used medicinally, especially that of the female plant, which is larger than that of the male. Ainslie states that the Hindu doctors prescribe the mucilagenous root in the form of electuary in cases of bleeding piles, and in certain bowl-affections connected with such complaints, the dose about two drachms or more are prescribed twice daily. Rheede states (ex D.E.P.) the plant is " truly cephalic ", for mixed with cocoanut pepper, red sandal wood and other ingredients to form a liniment it relieves all pain in the head. Dymock§ stated that the juice of the root is a domestic remedy in Konkan for the inflamation caused by contact with the urine of the house-lizard.

" The powder of the dried fruit introduced into the nostrils is said to give rise to repeated sneezing" (Surgeon Major W. D. Stewart, Cuttack). " The tuberous root of the female plant is used in Belgaum as an expectrant, and externally in ague cases as an absorbent. The root of the male creeper is used in ulcers, especially those caused by snake bites ". The unripe fruit is used as a vegetable and given as a delicacy to patients recovering from fever " (C. T. Peters, Zundra).

Food—The green fruit is eaten in curries. The tuberous root of the female plant are also eaten.

Occurrence

Burma	Bhamo, 14-2-68, Coll. J. Anderson ; Southern Shan States, Laihka, 1894, Coll. Abdul Khalil ; Keng Tung 5,000 ft., June 1909, Coll. Capt. R. M. MacGregor
Bengal	N. Bengal, Sikkim Terai, below Goreedora, 30-9-68, Coll. S. Kurz ; Chandernagar, August 1902 Coll., Abu Hosen ; Lauhajong, Vikrampore, Dacca, 11 Aug. 1871, Coll. C. B. Clarke ; Jatta Pagoda, Sundriban, 7 Aug. 1902, Coll. D. Prain ; Agartala 500-800 ft., Hill Tipperah 9-6-15, Coll. P. M. Debbarman
Assam	Haflong, N. Cachar, 2,675 ft., 10-8-1908, Coll. W. G. Craib ; near Badarpur, Dist. Sylhet, 12 Aug. 1903, Coll. A. T. Gage ; Umran to Umling along Shillong Gauhati Road, 16 June 1911, Coll. R. K. Das ; Khasia ; Mount Khasia, Coll. J. D. Hooker & T. Thomson ; Kohima, Naga hills Dist. July 1886, Coll. D. Prain ; Deongaon, July 1843 ; Dimapur, 400 ft. Sibsagar Dist., Coll. C. B. Clarke
Bihar	Dalsing Sarai, Darbhanga Dist., Aug. 1900 ; Coll. Dr. Prain's collector, Manbhum Coll. Rev. A. Campbell
C. I.	Abu 1868, Rajputana Coll. S. Kurz ; Guna, Isagarh Dist, Gwalior, Sept. 1867, Coll. G. King ; Chanda, C. P., Coll. Reporter of Economic Product, Govt. of India ; Chanda, C. P., 6th February, 1904, Coll. Reporter of Economic Products, Government of India
Punjab	1,000 ft., Coll. T. Thomson
N. W. Himalaya	Dehra Dun U. P., 20 July 1870, Coll. G. King ; near Dehra August 1882, Coll. Duthie ; Dehra Dun, July 25th 1870, Coll. G. King ; Anadra Aug. 1868, Coll. G. King ; N. W. India
Sikkim	Coll. G. King ; above Goreedora towards Punkabari, 30-9-68, Coll. S. Kurz ; Sikkim, 24-8-57, Coll. T. Thomson ; Sikkim, 3-6,000 ft., Coll. J. D. Hooker ; Pankabari July 1975, Coll. W. Gamble ; Ryang 2,000 ft., 19th August 1874, Coll. G. King ; Sikkim, Coll. S. Kurz ;
Pen. India	Travancore, Coll. Rama Rao ; Mundomurhi, Travancore State 27.8.1913, Madras Coll. C. C. Calder and M. S. Ramaswami ; Courtalum, Tinnevelly Dt., Madras 17 June, 1901 ; Karianshala, Anaimalai Hills 2,450 ft.; Madras-Cochin 1-10-12, Coll. C. E. C. Fischer ; Shevaroy Hills ; Mysore and Carnatic Coll. G. Thomson ; Bodinaikanur, December 1910, Coll. A. Meebold ; Quilon, Salem Dist, Travancore, Madras, June 1836 ; Mandandurai 700 ft., Tinnevelly Dist., 19 February 1913, Coll. D. Hooper & M. S. Ramaswami ; Balugaon, Chilka lake, Ganjam Dist., 8 August 1913, Coll. D. Hooper ; Karwar, N. Kanara, Dist. Bombay, 20 Aug. 1883, Coll. W. A. Talbot ;
Wall. Cat.	Prome, Burma 18th Sept. 1826 ; 6743 A ; Chittagong, Bengal 6743 A ; Sylhet Assam 6743 B ;

§ Dymock, W. (1885). *Materia Medica West India*, 339

4. ***Momordica macrophylla*** Gage. Rec. Bot. Survey of India, iii, no. 1, p. 61.

Branches angled and grooved, sparsely scurfily hairy in the grooves. Leaves petiolate, cordate, mucronate, with base cuneate at the insertion of the petiole, membranous glabrous or with a few scurfy hairs on the nerves, margin entire, basal nerves 3 including the midrib, the lateral ones almost at once dividing into two branches. Petiole 6 cm. long with one or more glands, lamina of fully developed leaf 13-8-16 cm. long ; 11-14 cm. broad at its widest part. Tendrils unbranched. *Male flowers* usually solitary or unbranched peduncles, sometimes three or four on as many pedicles, branching from a main peduncle. Peduncles shorter than the petioles. Bract broadly reniform entire, about 3 cm. from base to apex, about 3·8 cm. in transverse diameter, at the top of the peduncle completely enclosing the male flower. Flower unexpanded about 22 cm. long. Sepals oblong acute, thick and rather fleshy in the bud, twisted, pubescent. Petals yellowish without a black base. Stamens three, two 2-anthered, one 1-anthered, filaments black. *Female flowers :* on solitary and unbranched peduncles, very small bracteole at the middle of the peduncle, no bract encloses the female flower. Flower about 2 cm. in length. Sepals oblong acute, 8 mm. in length. Petals yellowish ovary oblong acute, spinscent. Ripe fruit about 6·5 cm., spinescent, spines 5-7 cm. long.

Flowers March to August.

Habitat

This species is confined to Burma. It was first collected by G. Gallately in 1877 and afterwards in 1903 by Col. A. T. Gage and subsequently by J. H. Lace (1908) and N. Anandale (1917). I have found in growing wild in the suburban areas round about the district town of Henzada (Burma). It climbes to a considerable height on the trees and the fruits hang down.

Occurrence

Burma . . . . . near Thoudaung, Maymyo Mandalay Road, Mandalay Dist., 24th August 1912, Coll. J. H. Lace ; Keng Tung 3,000 ft., S. Shan States, June 1909, Coll. R. W. MacGregor ; Tenasserim, Taepo 5,000 ft., 15-4-1877, Coll. Geo. Gallately ; Pomin River side—Minbu, Sept. 1902, Coll. Shaik Mokim ; Yawnghime, 5th March 1917, Coll. N. Anandale ; Maymyo plateau 3,500 ft., 12th July 1908, Coll. J. H. Lace

5. ***Momordica cochinchinensis*** Spreng. Syst. iii 14 ; Kurz. in Journ. As. Soc. 1877. pt. ii, 102, *M. mixta*, Roxb. Fl. Ind. iii, 709 ; W. & A. Prodr. 349 ; Miq. Fl. Ind. Bat. i, pt. i, 664 ; Bot. Mag. t. 5145 ; Naud. in Ann. Sc. Nat. Ser. 4, xii, 132 ; *M. diocia* Wall. Cat. 6750 A.B.C.D.E.F.; *Muricia cochinchinensis* Lour. Fl. cochinch. 733 ; DC. Prodr. iii, 318 ; Woodr. in Journ. Bomb. Nat. (1898) ii p. 640 ; Watt. Dict. Econ. Prodt. v. 5, p. 257 ; *Momordica mixta* Roxb.

Vern. : Sans. *Karkatka* ; Hind. and Beng. *Kakrol, kankur* (East. Bengal) Tel. *Adudi kakara ;* Burma *Samong uway.*

A strong climber often ascends on trees, dioecious ; root tuberous, perennial ; stem robust, angular, glabrous ; tendrils simple stout, angled, glabrous ; leaves suborbicular in outline, cordate at the base. 4-7 in., long and broad, glabrous on both surfaces, the margin near the base furnished with umbilicate glands, divided to the middle or almost to the base into 3 (rarely 5) lobes, the lobes ovate or oblong, lanceolate, acute or acuminate, diverging, the margins entire or faintly toothed ; petioles 2-3 in. long, stout, sulcate, almost invariably glandular at the middle and at the apex, glabrous or nearly so. *Male flowers* : peduncles 1-flowered, 2-6 in. long, angularly furrowed, more or less pubescent especially near the apex, bract at the top of the peduncle embracing the flower, broader than long, $1\frac{1}{8}$-$1\frac{3}{8}$ by $1\frac{1}{2}$-2 in., cordate at the base, pubescent or scabrid. Calyx hirsute or scabrid ; lobes $\frac{1}{2}$-$\frac{3}{5}$ in. long, oblong lanceolate, acute. Corolla white tinged with yellow ; pubescent outside more or less so inside ; segments reaching $2\frac{1}{2}$ by 1 in., obovate oblong or elliptic oblong, obtuse or subacute. *Female flowers* : peduncles 1-2 in. long with a small bract about the middle. Fruit 4-6 in. long, ovoid pointed, red, fleshy, terete, densely, covered with raised points about $\frac{1}{8}$ in. long. Seeds numerous, $\frac{7}{8}$ by $\frac{5}{8}$ by $\frac{1}{5}$ in. ovoid, much compressed, sculptured on both faces.

Flowers March to August.

Habitat

Bengal to Tenasserim common ; Deccan Peninsula Wight ; Kanara ; Law ; distrib. Formosa, Philippines.

Medicinal and other uses

It is stomachic and stimulant and is used in cough.

The fruit is occasionally used for food in Bengal.

In the inner epidermal cells of the leaves innumerable cystoliths of calcium carbonate of various fantastic structures are found. These cystoliths unlike those of *M. charantia* are branched and heteroplanous.*

In the stem, root and the petiole crystals of calcium oxalate of various systems are also met with in quantity.

Occurrence

N. W. P.	Saharanpur, 19-8-01
Bengal	Royal Botanic Garden, Calcutta ; Howrah Dist., June, 1869, Coll. S. Kurz ; Chittagong, I.L. Lister, 1876 ; Chittagong Hill Tracts, Dr. King's collector
Assam	near Badarpur 12th Aug. 1903, Coll. A. T. Gage ; Tingale Bam jungle, March 1899, Coll. Dr. Prain's collector ; W. Phasama, Naga Hills, 1886, Coll. Dr. D. Prain ; Sibsagar July 1845, Coll. Jenkins ; Sylhet, Coll. J. D. H. & T. T.; Karimganj, Sylhet, 12th May 1868.
Wall. Cat.	Royal Botanic Garden, Calcutta ; 6750 C ; 6750 D ; Kogun, 11th March, 1827 6750 F ; Sylhet, 6750 B.
Burma	Tanbingon Rest House, 150 ft., Bank of Myanng strem, Tharrawaddy Dt., Coll. C. Gilbert Rogers ; Mergui, April 1911, Coll. A. Meebold ; Letpanthaung March 1911, Coll. A. Meebold ; Thaungyu valley, Tidokui Chaung, Thanton Dist., 7th March, 1909, Coll. I. H. Lace.
Andaman	1884, Dr. King's collector ; Coattu Tang near Port Blair, 6-8-84, Dr. King's collector ; Ranguchang Hill jungle 3-11-1893, Coll. Dr. King's collector ; Dhani Khari hill jungle S. Andaman, 13-10-1894, Coll. Dr. King's collector ; Hobdaypur hill jungle S. Andamans 9-4-92, Dr. King's collector.
Malay Peninsula . . .	Salean River, Pahang ; Kelan Tujor, Perak, April 1892, Coll. L. Wray Jr.; Hulu Kenas, May 1884, Coll. B. Scortechini ; Ayer Laml. Perak, June 1888, Coll. L. Wray Jr.; Perak 500-6,000 ft., June 1884, Coll. Dr. King's collector ; Pachang, Ridley 1448 (et n. 2449) ; Penang ; Siam ; Pahang Track, State of Selangor, 1897.

6. ***Momordica denudata*** Hook. f. Brit. India II. 618.

Dioecious. A slender climber, nearly glabrous, tendrials simple. Leaves ovate-lanceolate, 2-4 by 1-2 in. deeply cordate, often 2-5 angled or sparingly 3-5 lobed, central lobe always long acute ; petiole 1 in. Flowers small many males on one raceme with inconspicuous bracts. Male peduncles 2 in. often somewhat panicled nearly from the base and 10-12 mostly pedicelled flower ; bracts at the base of the pedicles minute ; sepals ovate, acuminate ; petals $\frac{1}{5}$-$\frac{1}{3}$ in. filaments 3 inserted near the base of the calyx tube, anthers much exert, canduplicated. Female peduncle 1-flowered, about as long as the male bract minute near the middle. Fruit ovoid rostrate muricated with triangular papillae $\frac{3}{4}$ in. long and broad.

Habitat

Ceylon, alt. 3000-4000 ft., Gardner, Thwaites, Walker.

Occurrence

Peninsular India . . .	Kavalay Cochin 2,000 ft., November 1710, Coll. A. Meebold ; Trichoor, Travancore, Sept. 1884, Coll. G. S. Gamble.

* Chakravarty *Philipp. J. Sci.* (1937), 63. (4), 415

7. ***Momordica Cymbalaria*** Fenzl. ex Naud. in Arn. Sc. (1859) Nat. Ser. iv. xii 134 ; Hook F. In Oliv. Fl. Trop. Afr. ii. 540 ; *Luffa tuberosa* Roxb. Hort. Beng. 104 ; Fl. Ind. iii. 717 ; W. & A. Prodr. 344 ; *L. amara* Wall. Cat. 6754 B. Woodr. in Journ. Bomb. Nat. (1898) v. ii p. 640 ; *Momordica tuberosa* Cogniaux. in DC. Monogr. Phan. (1881) v. 3 p. 454.

Vern. : Mar. *Kadavanchi.*

Monoecious ; root woody, tuberous, perennial : stem very slender, scandent, branched, striate, pubescent or subglabrous. Tendrils filiform, slightly pubescent, simple. Leaves orbicular reniform in outline, ¾-1¼ by 1-2 in., glabrous with a few scattered hairs, punctate (but not scabrid) on both surfaces, deeply cordate at the base, obtusely but not deeply 5-7 lobed, lobes short, acute or obtuse ; petioles ½-1½ in. long, striate, pubescent. *Male flowers* ; in 2-5 flowered racemes ; peduncles ¼-1 in. long, filiform, pubescent ebracteate : pedicles ⅛-⅜ in. long. Calyx hairy ; tubes short, broadly campanulate, narrowed at the base, lobes ¼ in. long, lanceolate, acute. Corolla pale yellow ; segments obovate, obtuse. ⅜-½ in. long. Stamens 2 : filaments very short, thick flattened ; anthers 1/12 in. long, one 2-partite, the other 3-partite, the cells conduplicate, the connective broad. *Female flowers* : peduncles ¾-1½ in. long, slender, ebracteate, ovary fusiform, beaked ; style stout ; stigmas 2, spreading, 2-partite. Fruit ¾-1 in. long, pyriform or broadly fusiform, narrowed into the curved peduncle, fleshy, dark green, 8-ribbed, sparsely hairy. Seeds ⅙-¼ in. long, broadly ovoid, slightly compressed, strophiolate, not margined : testa polished and shining, dark brown.

Flowers June to July.

Habitat

Deccan Peninsula, Wight ; Mysore, Hyne ; Konkan, Stock. Distrib. Tropical Africa.

Medicinal use

*Dymock** writes " The whole plant is acrid : it is mentioned that a number of tubers were forwarded to the Chemical Analyser to Government from Satara as having been found in the possession of a person suspected of administering drugs to procure abortion. My specimen was grown from one of these tubers, which still retains vitality. *Dr. Lyon*, the Chemical Analyser, informs me that on reference to the records of his office he finds that Kadavanchi tubers have been three times sent to him within the last four years, as having been used to procure abortion."

Occurrence

India Distrib.	Sholapur district Bombay, Satara, Bombay ; Naraina S. M. Country ; Dharwar, Bombay, Woodrow ; Jaipur, Rajputana.
Peninsular India . . .	Pemkacherla, 1,200 ft., Anantapur Dist. Madras July 1889, J. S. Gamble.
Central India	Guna, Isagar Dist., Gwalior 1867, Coll. G. King.

10. Cucumis

Cucumis, Linn. Gen. (1737), p. 296 edit. 6, p. 508, spec. edit. 1, p. 1011, edit. 2, p. 1435 ; Reich. Gen. p. 504 ; Juss. Gen. p. 395 ; Neck. Elem. 1, p. 237 ; Lour. Fl. Cochinch. 2, p. 591 ; Schreib. Gen. 2, p. 663 ; Thunb. Prodr. pl. Cap. 1, p. 13, Fl. Cap. 1, p. 156 ; Vent. Tabl. 3, p. 515 ; DC. Fl. Franc. 3, p. 690 ; Willd. Spec. 4, p. 611 ; Lois. in Dict. sc. nat. 10, p. 226 ; Ser. in DC. Prodr. 3, p. 299 ; Roxb. Fl. Ind. 3, p. 719 ; Wight et Arn. Prodr. 1, p. 341 ; Spach, Veg. phan. 6, p. 205 ; Meisn. Gen. p. 127 (91) ; Endl. Gen. Pl. p. 938 ; Torr. et Gr., Fl. N.-Amer. 1, p. 543 ; Arn. in Hook. Journ. of Bot. 3, p. 278 ; Wight in Ann. and Mag. of Nat. H. 8, p. 270 ; Roem. Syn. fasc. 2, p. 15, 68 ; Miq. Fl. Ind. Bat. 1, parti, p. 670 ; Naud. in Ann. sc. nat. ser. 4, v. 11, p. 9 et v. 12, po. 108 ; Sond. in Harv. et Sond. Fl. Cap. 2, p. 494 ; Benth. et Hook. Gen. pl. 1, p. 826 ; Hook. f. in Oliv. Fl. trop. Afr. 2, p. 542 ; Boiss. Fl. Orient. 1, p. 758 ; Cogn. in Mart. Fl. Brass. fasc. 78, p. 15 ; Clarke in Hook. f., Fl. Brit. Ind. 2, p. 619. *Cucumis et Melo* Tourn. Inst. p. 104, tab. 31, 32 (1700) ; Adans. Fam. 2, p. 138. —Rigocarpus, Neck. Elem. *1*. p. 238 (1790).

* Dymock, W. (1885). *Materia Medica West India* 341

Annual herb with a perennial root, climbing or trailing, hispid or scabrous. Tendrils simple, sometimes stright and spinescent. Leaves entire or palmately 3-7-lobed or 5-angled. Flowers yellow, monoecious. Male flowers fascicled (rarely solitary). Calyx tube turbinate or campanulate; lobes 5, corolla subcampanulate, deeply 5-lobed or 5-partite. Stamens 3 free; filaments short; anthers free oblong, one 1-celled, the others 2-celled, the cells linear, straight, curved or flexuose, the connective produced above into a papillose appendage. Pollen smooth. Rudimentary ovary glanduliform. Female flowers solitary. Calyx and corolla as in the male. Rudimentary stamens 0. Ovary ovoid or globose, 3-5-placentiferous; ovules many, horizontal; style short; stigmas 3, obtuse. Fruit fleshy or corky, globose or cylindric terete or obtusely 4-angled, smooth or echinate, indehiscent, or 3-valved and tardily deliscent. Seeds numerous, oblong, compressed, usually smooth. Dist. Tropical Asia and Africa, a few in Australia and America; species 26.

KEY TO THE SPECIES

A. Fruit smooth, glabrous or pubescent
  B. Perennial; leaves deeply cut into 5-7 obtuse lobes, scabrid . . . 1. *C. trigonus*
  BB. Annual; leaves usually 5-angled softly hairy, spherical ovoid elongated or contorted . . . . . 2. *C. Melo.*
  BBB. Annual; 5 angular or slightly lobed, hispidulous, fruit glabrous sometimes tuberculated commonly elongate . . . . . 3. *C. sativus*
AA. Fruit echinate . . . . . 4. *C. propheterum.*

1. ***Cucumis trigonus*** Roxb. Hort. Beng. 70; W. & A. Prodr. 342; Wight Ic. t. 497; Wight Ill. t. 105; Boiss. Fl. Orient. ii, 758; Dalz. and Gibs. Bomb. Fl. 103; Naud. in Ann. Sc. Nat. Ser. – 4. xi. 30; *C. turbinatus* Roxb. Fl. Ind. iii 723; Miq. Fl. Ind. Bat. i, pt. i, 671; *C. maderaspatanus* Roxb. l.c. Wall. Cat. 6734; *C. Melo.* var. *agrestis* Naud. l.c. 73; *C. pubescens* Wall. Cat. 6729; Royle Ill. t. 47; *C. pseudo-colocynthis* Royle, Ill. t. 47; *C. eriocarpus* Boiss. Diagn. ii 59; *Bryonia callosa* Herb. Rottler; F.B.I. v, 2, p. 619; Woodr. in Journ. Bomb. Nat. v. ii (1898) p. 640; Watt. Dict. Econ. Prod. v. 2, p. 635.

Perennial, scabrid, monoecious: stems 3-5 ft. long, slender, angled, rough with short rigid hairs Tendrils simple. Leaves sub-orbicular in outline, 1-2 in. long and broad (sometimes larger), scabrid on both surfaces, hispid on the nerves beneath, cordate at the base, deeply palmately 5-7-lobed, the lobes ovate oblong or obovate, often narrowed at the base, rounded at the apex, lobulate or dentate; petioles slender, striate, scabrid, often hispid ½ to 2 in. long. *Male flowers*: peduncles slender ⅛-⅜ in. long, in small clusters (rarely solitary). Calyx narrowly campanulate, hairy: tube ⅛-⅙ in. long: teeth short, subulate. Corolla yellow, ⅙-¼ in. long: more or less pubescent: segments elliptic, acute. Appendage of the connective of the anthers a little shorter than the anthers. *Female flowers*: peduncles slender ½-1 in. long in fruit. Ovary hairy. Fruit ellipsoid or sub-globose, when young strongly echinate gradually becoming smooth at maturity, 1½ by 1½ in. In Bombay districts, 2-2½″ × 1½″-2″: longitudinally veriegated with 10 green stripes, pale yellow when ripe with bitter pulp. Seeds white ellipsoide, not margined.

Flowers June to October.

Habitat

Throughout India. Distributed to Malaya, North Australia, Afghanistan, Persia. The mountain tracts of Coromandel. Central Bengal. Central Provinces and the Punjab.

Occurrence

Central India	Indore 30-8-18, Coll. P. Mukerjee; Sagor
Wall. Cat.	Royal Botanic Garden, Calcutta 6734 D
Pen. India	Madras; Yettanhatti 1,000 ft., Bellary, July 1885, Coll. G. S. Gamble; Kalija, Chilka Lake, Ganjam Dt., 10 August 1913, Coll. D. Hooper; Thana, Bombay Nov. 23, 1898, Coll. G. M. Ryan; Coimbatore 1,000 ft., 5th April 1870, Coll. C. B. Clarke; Shevaroi Hills, S. India; Mettupellayam, 1,100 ft., Combatore Dist., 4-8-1910, Coll. C. E. C. Fischer; Sind; Sewnen Fort, 1878, Bombay Coll. W. Dalzell; Devarapalli 500 ft., Rampa Dist., Coll. V. Narayanaswami.
N. W. Himalaya	Dehra Dun, 1869, Coll. G. King
Bengal	Matla, Oct. 1898, Coll. Shaik Mokim; Bengal, Coll. S. Kurz.

2. ***Cucumis Melo*** Linn. Sp. Pl. 1753, 1011 ; Roxb. Fl. Ind. iii 720 ; Wall. Cat. 6738 : W. & A Prodr. 341 ; Jacq. Monog. du Melon t. 1-33 ; *C. utilissima* Roxb. l.c. 721 ; Wall Cat. 6731 ; *C. flexuosus* Linn.; *C. maculatus* Willd.; *C. Garmia* and *C. Chata* Wall. Cat. 6726 ? and 6727 ; *C. cicatrisatus* Stocks. In Hook. Kew. Journ. Bot. iv. 148 : Watt. Dict. Econ. Prodt. v. 2 p. 627 : Cogniaux. in DC. Monogr. Phan v. 3 (1881) p. 483.

The sweet melon. Vern. Sans. *Karmuja ;* Beng. *Kharmuj, phuti, kakur, bangi ;* Hindi. *Kharbuja, kharbuj ;* Sant. *Tarbuj ;* C.P. *Dungra ;* Kangra *Kharbuza ;* Bomb. *Kharbuja, kharbuj ; chibuda ;* Mar. *Chibunda ;* Guz. *Tarbucha ;* Sind *Gidhro* ; Ladak. *Zaghum* ; Afghan. *Sarda* or *sirda paliz ;* Tam. *Vellari verai ;* Tel. *Mulampunda ;*

Annual, stem creeping, branched, obtusely angular with stiff (sometimes hooked) hairs on the ridges. Tendrils simple. Leaves 2-4 in. long and about as broad as long, acute, at the apex, cordate at the base more or less hairy on both sides, denticulate, usually 5-angled : petioles 1-1½ in. long, grooved and roughly hairy. *Male flowers* in axilary fascicles of about 2-3 : peduncles ¼-½ in. long, very slender densely hairy Calyx densely hairy ; the tube narrowly campanulate, ⅛-⅙ in. long : teeth $\frac{1}{10}$ in. long, subulate, densely hairy. Corolla ¼-⅜ in. long, the segments hairy outside, often terminated by a hairy apiculation. *Female flowers* : calyx tube constricted above the ovary. Ovary ellipsoid, clothed with long bristly deciduous hairs. Fruit ellipsoid or turbinate, about 1½ in. long, smooth or with a few small bristles. Seeds numerous, narrowly ovoid, compressed smooth.

Flowers January to October.

There are several varieties differing in properties and in the size, shape and appearance of the fruit. Duthie and Fuller describe two varieties. Var. 1 *Momordica* and var. 2 *Utilissima* (Field and Garden Crops, 1882, tt. 53, 54). Var. *agrestis* is common in the neighbourhood of Bombay and on the Western Ghats.

Habitat

Cultivated throughout India, especially in the sandy beds of rivers. Distributed through cultivation in most hot countries and according to Clarke it may be a cultivated form of *C. trigonus*. The origin of the plant is uncertain. M. de Candolle considers it to be probably a native of N. W. India, Baluchistan and perhaps tropical Africa.

Several cultivated varieties of this species are met with in India. It is difficult to enumerate all the varieties in absence of authentic specimens. The two predominating varieties, viz., (1) *momordica* (2) *utilissima* are given below. Var. *momordica*. The fruit is cylindrical, smooth, not fluted but it is frequently mottled. Two forms of this variety are readily recognised the one grown in the rains and the other in the hot season. The fruit bursts spontaneously when ripe : it may grow upto 2 ft. in length and upto 6 inches in diameter. The seeds are smaller than the var. *proper*.

The seeds are used as a cooling medicine.

The fruit is much eaten by the Indians and the Europeans alike, when young they may be used as substitute of cucumber, when ripe, with the addition of a little sugar, they are scarcely inferior to the melon and reckoned very wholesome.

Cultivated here and there throughout India.

Var. *utilissima :* Beng. ***Kakur*** or *kankur, kakri.*

The fruit varies from short oval or cylindrical to elongate and is either straight or curved like some varieties of cucumber. The seeds are smaller and slender than melon proper. Cultivated in Bengal, the North-West Provinces and the Punjab during the hot weather and the rains.

The seeds of these useful species of cucumis are described as cooling, edible, nutritive, and diuretic, and are used in painful micturition and suppression of urine. Two drachms of seeds, rubbed into a pulp with water, are given alone or in combination with salt and Kanjika (U.C.Dutt) O'Shaughnessy* says " The powder of the toasted seed powerful diuretic, and serviceable in promoting the passage of sand or gravel ".

* O'Shaughnessy (1841). *Bengal Dispensatory and Pharmacopœia*, 351.

Occurrence

Assam	Dhekia juli, April 1902, Coll. A. C. Chatterjee ; Singrabari April 1902, Coll. A. C. Chatterjee ; Dhubri, June 1902, Coll. A. C. Chatterjee ; Margherita February 1902, Coll. A. C. Chatterjee ; Gouhati north side of Brahmaputra, April 1902, Coll. A. C. Chatterjee ; Orang, March 1902,Coll. A. C. Chatterjee ; Mangaldai March 1902, Coll. A. C. Chatterjee ; Nazira, July 1843 ;
Bengal	Howrah Dist., Sept. 1869 ; Coll. S. Kurz ; Agartala 800-1,000 ft., Hill Tipperah 27-9-14, Coll. P. M. Debbarman ;
Burma	Pegu, Coll. S. Kurz ; Pagan, 3-1-68, Coll. Anderson ; opposite Minbu town 8th March 1903, Coll. Aubert & Ghose.

3. ***Cucumis sativus*** Linn. Sp. Pl. 1012 ; Lamk. Ill. t. 795 ; Roxb. Fl. Ind. iii 72 ; Wall. Cat. 6737 ; W. & A. Prodr. 342 ; Miq. Fl. Ind. Bat. i. pt. i, 671 ; Naud. in Ann. Sc. Nat. Ser. 4, xi, 27 ; Kurz. in Journ. As. Soc. 1877. pt. ii, 103 ; *C. muricata* Wall. Cat. 6735 A ; *C. Hardwickii* Royle Ill. t. 47.

The cucumber. Vern. Sans. *Sukasa, Trapusha ;* Hind. *Khira ;* Beng. *Sasa, khira ;* Orissa *Kakai ;* Pb. *Khira, khiyar ;* Simla *Kakri ;* Bomb. *Kakri ;* Mar. *Kakdi* ; Tam. *Mulevekri ;* Tel. *Doza-koia* ; Kan. *Santa kayi.*

Stems scabrous. Leaves ovate 5-angular or slightly lobed, lobes acute hispidulous on both surfaces and also often with soft hairs, 3-5 in. diam. petiole 2-3 in. Female peduncles sometime 2, petals $\frac{3}{8}$ in. young ovary muricate with rigid prickles. Fruit glabrous sometimes tuberculated commonly elongate, 12 by $1\frac{1}{2}$ in.

Habitat

Throughout India, cultivated. Distributed in all the warm and warm-temperate countries, cultivated. Wild not known.

There are two primary varieties of this species, one a creeping plant cultivated in the fields during the hot season and the other a climber cultivated near the homesteads during the rains. The hot weather variety bears small egg shapped fruit, which is generally greenish or blackish in colour. It is sown in February to March in any soil, preferably a rich one. This is the proper *khira* or *khirai* of East Bengal. The fruits are smaller, thicker, globuler or bluntly triangular.

The rainy season variety has much larger fruits. There are two forms of this variety, the one having dark green fruits and the other of creamy white colour ; both when full grown turn rusty brown. The rainy season variety is the most common and is universally eaten by people of all classes. Both these varieties are eaten raw but the latter variety with cylindric fruits are generally used in the curry.

Medicinal use

The leaves, boiled and mixed with cum in seeds, roasted and powdered, are administered in the throat affections. Powdered and mixed with sugar they are also powerfully diuretic and are sold in the bazars of Upper India.

" In sunstroke, pieces of cucumber are put on the bed so that the patient may breathe moistened air in order to nutralize the heat of the body " (A Surgeon).

The seeds yield an oil.

Occurence

Assam	Sadiya August 1909, Lakhimpur, Coll. R. K. Das ; Nowjan 400 ft., Naga Hills, 14. Oct. 1885, Coll. C. B. Clarke
N. W. Himalaya	N. W. India ;
Wall. Cat.	Kenvarikot, 24. April 1809, 6737 B
Bengal	S. Kurz ; Agartala 600-800 ft., Hill Tipperah Sept. 1915, Coll. P. M. Debbarman ; Royal Botanic Garden, Calcutta Bamunpukri 30-7-76
Burma	Pegu February 1901, Coll. S. Kurz
Laccadives	Kiltan, 1891, Coll. H. N. I.M. " Investigator "
Sikkim	Kalimpong 4,000 ft., Darjeeling 9. Dec. 1879, Coll. G. S. Gamble ; Sal Forest 1879, Coll. G. King
Pen. India	Chintagandi Hill near Marudumalli, 1,000 ft. Rampa District, 30-9-20, Madras Presidency, Coll. V. Narayanaswami
Central India	Abux, 1868

4. ***Cucumis prophetarum*** Linn. Cent. i. 32 ; Wall. Cat. 6733 ; W. & A. Prodr. iii. 342 ; Boiss. Fl. Orient. ii. 758 ; Naud. in Ann. Sc. Nat. Ser. 4. xi. 14 ; F. B. I. v. 2. p. 619 ; Woodr. in Journ. Bomb. Nat. v. ii (1898) p. 640.

Monoecious. Stem slender, branched, angled and grooved, scabrid. Tendrils very short, striate, sometimes o. Leaves polymorphous, rigid $\frac{3}{4}$-2 in. long and broad, somewhat ash coloured, scabrid, coarsely hairy on the nerves beneath, cordate or truncate at the base, frequently 3-lobed, the lobes often lobulate with rounded apices, the terminal lobe often contracted at the base ; nerves prominent beneath ; petioles $\frac{1}{2}$-1 in. long. *Male flowers* solitary or fascicled ; peduncles filiform densely hairy, $\frac{1}{10}$-$\frac{1}{4}$ in. long. Calyx tube subcylindric, $\frac{1}{6}$ in. long ; segments ovate oblong, subacute. Filaments filiform, slightly hairy ; anthers oblong, the appendage of the connective slightly dilated at the apex. *Female flowers* : peduncles (in fruit) stout, $\frac{1}{2}$-1 in. long. Fruit subglobose 1-1$\frac{1}{2}$ in. long and nearly as broad, longitudinally striped with green and white, echinate, the spines not or scarcely pungent, $\frac{1}{20}$-$\frac{1}{8}$ in. long. Seeds ellipsoid, not margined, $\frac{1}{6}$ in. long.

Flowers July to August.

Habitat

In Bombay Presidency, it is confined to Sind. Distributed to Baluchistan, Arabia, Tropical Africa to Guinea.

Occurrence

Bombay . . . . Landhi, Karachi, Sind, 13th August, 1912, Coll. D. Hooper ; Sind, Coll. J. E. Stocks

11. Citrullus

Citrullus, Neck. Elem. 1. p. 240 (1790) ; Schrad. in Eckl. et Zeyh. Enum. pl. Afr. austr. 2, p. 279 et in Linnaea, 12, p. 412 ; Meisn. Gen. p. 126 (91) ; Spach. veg. phan. 6, 212 ; Endl. Gen. p. 937 ; Roem. Syn. fasc. 2. p. 12. 49 ; Webb et Berth. Phyt. Canar. 2. p. 3 ; Miq. Fl. Ind. Bat. part 1. p. 661 ; Naud. in Ann. sc. nat. ser. 4. v. 12. p. 99 ; Benth. et Hook. Gen. 1. p. 826 ; Hook. f. in Oliv. Fl. trop. Afr. 2. p. 548 ; Cogn. in Mart. Fl. Bras. fasc. 78. p. 18 ; Clarke in Hook. f. Fl. Brit. Ind. ii. p. 620.—*Colocynthis* Tourn. Instit. p. 107. *Cucurbitae et Cucumeris spec.* Auct.

Perennial herbs usually trailing. Tendrils 2-3-fid, rarely undivided. Leaves deeply 3-7-lobed, the lobes usually lobulate. Flowers rather large, yellow, monoecious, all solitary. *Male flowers* : calyx tube broadly campanulate ; lobes 5. Corolla 5-partite beyond the middle, sub-campanulate ; segments oblong ovate, obtuse. Stamens 3 ; filaments short, free ; anthers scarcely cohering, one 1-celled, the other 2-celled, the cells linear, flexuose, the connective not produced. Pollen smooth. Rudimentary ovary glanduliform. *Female flowers* : calyx and corolla as in the male. Rudimentary stamens 3, setose or ligulate. Ovary ovoid, 3-placentiferous ; ovules many, horizontal ; style short ; stigma 3, thick, reniform. Fruit globose or ellipsoid, smooth, fleshy, indehiscent. Seeds very many, much compressed, smooth. Distributed to the Eastern Mediterranean region, Tropical Africa, Western Asia. Species 3.

Key to the species

Leaves hoarsely scabrid ; fruit globose small . . . . . 1. *C. colocynthis*
Leaves glabrous or somewhat hairy, hardly scabrid ; fruit generally larger 2. *C. vulgaris*.

1. ***Citrullus Colocynthis*** (Linn) Schrad. in Linnaea xii (1838) 414 ; Arn. in Hook. Journal Bot. iii. 276 ; Wight Ic. t. 498 ; Miq. Fl. Ind. Bat. i. pt. i. 662 ; Naud. in Ann. Sc. Nat. ser. 4. vol. xii. 99 ; Dalz. & Gibs. Bomb. Fl. 101 ; Boiss Fl. Orient. ii 759 ; *Cucumis colocynthis* Linn ; DC. Prodr. iii. 302 ; Roxb. Fl. Ind. iii. 719 ; Wall. Cat. 6732 ; W. & A. Prodr. iii. 342 ; Woodr. in Journ. Bomb. Nat. v. ii (1898) p. 640 ; F.B.I. ii. p. 619 ; Watt. Dict. Econ. Prod. v. 2, p. 635.

Colocynth. Vern. Sans. *Indravaruni, vishala, indralvaruni, makhal* ; Hind. *Indrayan, makal* ; Beng. *Makal, indrayan* ; Pb. *Indrannmaraghune, kartuma, ghurumba, kartummae, tumbi, ghurumba,*

vishlumba (*nanzal* and *indrayan* fruit ; *tukkhm* and *tumna* seeds) ; Sind. *Tru-jo-gosht, tru-jo-par ;* Guj. *Truna deda, tras, indravana, indravena, indrak ;* Bomb. *Indrayan ;* Mar. *Indrayan indravana ; kadu vrindavana, thorli indrayan ;* Tam. *Paycumuti, pey-ko-mattimmatti, peyt-tumatti, verit-tumatti.* Tel. *Pusta, kaya-choythupusta* ; Kan. *Tumti kayi.*

Monoecious ; root perennial ; stems diffuse or creeping, slender, angled, branched, hirsute or scabrid. Tendrils simple or 2-fid, slender, hairy. Leaves very variable 1½-2½ by 1-2 in. in the wild form (larger in the cultivated one), usually deltoid in outline, pale green above ashy beneath, scabrid on both surfaces, 5-7-lobed or very commonly 3-lobed, the middle lobe the largest, each lobe deeply pinnatifid or sinuate lobulate, the segments obtuse ; petioles ½-1 in. (larger in the cultivated form) densely hirsute. *Male flowers* : peduncles ¼-½ in. long, villous. Calyx hairy, campanulate, ¼ in. long ; teeth lanceolate, $\frac{1}{12}$ in. long. Corolla ¼ in. long, pale yellow ; segments obovate, apiculate. *Female flowers* : ovary ellipsoid, densely hairy. Fruit globular slightly depressed, 2-3 in. in diam., variegated green or white, glabrous when ripe filled with a dry spongy vety bitter pulp ; epicarp thin. Seeds ⅛-¼ in. long, pale brown.

Flowers November to January.

Habitat

Throughout India, cultivated and very often apparently wild. Distributed to Western Asia, Arabia, all over Africa except the Cape, Spain.

Medicinal use

The Pharmacopœia of India describes colocynth as a hydragogue cathartic, useful in constipation, hepatic and visceral congestions, dropsical affections, and other cases requiring purgatives. Sanskrit writers describe the fruit as " bitter, acrid, cathartic and useful in jaundice, ascitis, enlargement of the abdominal viscera, urinary diseases, rheumatism etc. An oil prepared from the seeds of Indian cylocynth is used for blackening grey hairs. A poultice of the root is said to be useful in inflammation of the breasts (U. C. Dutt, Mat. Med. Hind.). According to the Muhammadan writers, colocynth is a drastic purgative, which removes phlegm from all parts of the system. They recommend the fruit, leaves and root in costiveness, dropsy, jaundice, colic, worms, elephantiasis etc. It acts as an irritant on the uterus, and its fumigation brings on the menstrual flow. The author of the Makhzan describes a curious mode of administration. " A small hole is made at one end of the fruit and peeper-corns are introduced ; the hole is then closed, the fruit enveloped in a coating of clay and buried in the hot ashes near the fire place for some days ; the pepper is then removed and used as a carminative aperient. Similar preparation is made with rhubaub root instead of pepper " (Dymock, *Meteria Medica West Ind.*). Murray* in his *Apparatus Medicaminum*, recommends the use of tincture of colocynth in cases of gout, rheumatism, violent headaches and palsy, in doses of fifteen drops, morning and evening. Dr. Kirkpatrick states that the rind with rhuburb is used by the native practitioners in supression or repression of urine. Colocynth is rarely employed alone, it is generally given in combination with other purgatives and carminatives. It commonly causes griping when used alone ; in excessive doses it produces inflammation of the intestines and even death. The principal efficient forms for the use of this drug are the compound extract of colocynth, compound colocynth pill and colocynth and henbane pill (Bently and Trim. Med. Pb. 114). From the pulp of this fruit a watery extract is prepared, which is much employed as a purgative in the form of pills.

According to Dalzell and Gibson† a compound extract of colocynth is prepared in large quantities at Hewra, for the supply of the medical stores. In the Punjab the fruit is extensively employed as purgative for horses. The pulp of the fresh fruit mixed with warm water, or the dried pulp with ajwan, is reckoned as a special remedy in cholera. The dried root reduced to powder is given as a purgative (Bellew in Watt's *Dictionary of Economic Products*). Stocks says the root and the juice are both used medicinally in Sind. In a report of the drug shown at the late colonial and Indian exhibition from Baroda, the properties of the fruit and root are given in very nearly the same terms

* Murray, J. A. (1881). *Plants and Drugs of Sind*, 39

† Dalzell, N. A. and Gibson, A. (1861). *The Bombay Flora*, 101

as above. So that the knowledge of this drug seems very extensively diffused over India. "Used in dropsy and amenorrhoea" (T. Ruthnam, Madras). "First rate medicine in asthma" (V. Ummeg-udien, Mettapollian, Madras).

Act. Prin.: Bitter substance,: Colocynthin, Colocynthetin.

Official preparation– Extract of colocynth, dose ½ grain: compound extract of colocynth dose 4 grains.

Peninsular India . . .	Bodinayakanur, Madura Dist., Madras, December 1910, Coll. A. Meebold; Bukkapatam 2,000 ft., Anantapur District, Madras, July 1884, Coll. J. S. Gamble; Tirukarnugudi Tinnevelly Dt., Madras 11th February 1913, Coll. D. Hooper and M. S. Ramaswami; Nandavaram, Nellore Dist., 24. July, 1914, Coll. M. S. Ramaswami
N. W. Himalaya . . .	Sutlej valley, Kumharsain (Punjab States), Kulu and Kangra, 3,500 ft. Punjab 26th September, 1894, Coll. Reporter on Economic Products to the Govt. of India; Punjab 1,000 ft., Coll. T. Thomson; Afghanistan & Northern Baluchistan Coll. T. E. T. Aitchison
Baluchistan	Nal. Kalat Beluchistan, 1877, Coll. O. T. Duke; Kacha Daman, Kalat, 5,000 ft., 28th July 1912, Coll. A. Watson; *Makai ?* 3,000 ft., 22nd August 1912, Coll. A. Watson; Karwa Tu (Sind); Mir Ali Khel, 3,600 ft., 18-5-96, Coll. Harsukeh; Banks of Jamua 2nd July 1813, 6732 B, Wall. Cat.; Nilikach 1,500 ft., 23-5-95, Waziristan, Coll. Harsukeh; Lar Koh 3-4,000 ft., Sept. 1912, Coll. Lieut. G. E. Everett.

2. ***Citrullus vulgaris*** Schrad. ex Eckl. & Zeyh. Enum. 279: Naud. in Ann. Sc. Nat. ser. 4, xi, 100; Dalz. & Gibs. Bomb. Fl. 102: Kurz. in Journ. As. Soc. 1877, pt. ii, 103; C. fistulosus stocks in Hook. Kew Journ. Bot. iii, t. 3; *Cucumis citrullus* DC. Prodr. iii. 301; *Cucurbita citrullus* Linn. Roxb. Fl. Ind. iii, 729; Wall. Cat. 6717; W. & A. Prodr. 351: Watt. Dict. Edcon. Prod. v. ii. p. 331, and Woodr. Gard. in Ind. ed. 5, p. 331.

The water melon. Vern. Sans. *Tarambuja, chayapula*; Hind. *Turbuza, tarbuz, tarmuz, karbuz, habinda, hindirana, samanka*; Beng. *Tarbuza, tarmaj*; Pb. *Tarbuz, mathira, nindal*; Sind. *Karigo, chanho, meho*; Guj. *Tarbuch, turbuch, karinja*; Bomb. *Turbuj, kabingad, kalinga, pharai*. Mar. *Turbuj, Kalingada*; Tam. *Pitcha, pullum*.

A climbing or trailing, hispid annual. Stems branching, angular; tendrils 2-fid, firm; pubescent. Petioles about 2 in. nearly round, villous; blade of leaf 3-5 in. long by 2-3 in. broad, triangular ovate, cordate, deeply trified; segments pinnatifid, terminal one larger; lobes undulate or lobulate, pale green above, ashy beneath. Flowers monoecious, axillary, solitary, rather large. *Male flowers*: peduncle shorter than the petiole: calyx campanulate, lobes narrowly lanceolate. Corolla about an inch in diam., greenish outside and villous: segments ovate, oblong, obtuse, 5-nerved, stamens 3, anthers free. *Female flowers*: calyx tube fused with the ovary, contracted above, lobes and corolla as in the male: ovary ovoid: densely villous: style short, stigmas 3. Fruit large, ovoid, pale or dark green or mottled, some times covered with a glacous waxy bloom: flesh white, yellowish or red, at times deeply pink. Seeds compressed, and usually margined, varying much in shap and colour. Some of the verieties grown in Alibay in the Kolaba District, have glacous green globose fruits.

Var. *fistulosus* Stocks Squash melon. Punjab. *Tinda*, has thick steams, leaves sparingly lobed, and is plentifully supplied with long somewhat hispid hairs. The fruits are almost round and are of the size of a criket ball with sparingly spinous hairs on the surface. Used in vegetable before it is full grown. Cultivated in North India.

Habitat

Cultivated throughout India. Distributed through cultivation in all warm countries of the world.

The wild plant may be either bitter or sweet without any observable structural differences. The bitter form comes very close to *C. colocynthis*, when that species is cultivated (Watt). Cultivated throughout India.

Linnaeus believed it to be a native of Southern Italy, while Seringe supposed it to be indigenous to India and Africa. It was afterwards discovered that it grew wild in Tropical Africa. "Livingstone

saw districts literally covered with it, and the savages and several kinds of wild animals eagerly devoured the wild fruit." It was cultivated by the ancient Egyptians, as appears from their paintings. The chinese only received the plant in the tenth century of the Christian era (DC., Orig. Cult. Pl. 263).

Medicinal and other uses

The seeds are used as a cooling medicine. Dymock* says that they are in great demand and kept decorticated and ready for use. In Bombay they are considered cooling, diuretic, and strengthening, and are sold in the bazars along with other cucurbitaceous seeds. Ainslie† remarks that the vytians prescribe the juice of the fruit to general thirst, and also as an anticeptic in typhus fever, in which cases he himself administered it with good results.

" Cooling as well as a diuretic " (Asst. Surgeon Ananda Chandra Mukerjee, Noakhali).

Oil : The seeds yield a clear, bland, pale coloured, limpid oil, used for burning the lamps, and probably also as an edible oil (Watt's *Dict. Econ. Products*).

The fruit is wildly used by all classes of Indians as a cooling sweet drink during the summer to quench thirst. *Tinda* (*C. vulgaris*, var. *fistulosa*) is a common vegetable in Northern India.

Occurrence

Peninsular India . . .	Mysore and Carnatic (cultivated), Coll. G. Thomson ; Trichonopoly, 3rd September 1878, Coll. G. King
Punjab	Amritsar, June 1855
N.W.P.	Banda (cultivated) 17th May 1901, Coll. Mrs. A. S. Bell
Bihar	Pukhuria, Manbhum, Coll. Rev. A. C. Campbell
Bengal	Dacca, 16th June 1872, Coll. C. B. Clarke ; Agartala 300 ft. Hill Tipperah, April 1921, Coll. P. M. Debbarman ; Coll. S. Kurz ; Harinkhola, Jahanabad, 12th March 1902, Coll. J. D. Naskar ; Goghat, Hughly Dist., August 1902, Coll. A. Hossain Dingra Ghat, 29th August 1877, Coll. G. King ; Royal Botanic Garden, Calcutta
Burma	Kamamoung, Salween, June 1912 Coll. A. Meebold ; opposit Minbu town, 8th March 1903, Minbu District, Coll. Gage ; Sujin, August 1891, Coll. Abdu Huk
Gangetic Plain	Gorakhpur 2-5-98
N. India	Multan, Bombay, Coll. Dalzell
Assam	Dhubri, February 1902, Coll. A. C. Chatterjee
Pen. India	Karachi, 1st May 1913 (var. fistulosus)

12. Coccinia

Coccinia Wight & Arn. Prodr. (1834) p. 347. *Cephalandra* Schrad. in Eckl. & Zeyh. Enum. Pl. Agr. Austr. (1836) p. 280.

Slender scandent or prostrate herbs, root often tuberous. Tendrils slender simple. Leaves petiolate, deltoid, or subrotund, angled or lobed, sometimes glandular beneath. Flowers rather large, white or yellow dioecious. *Male flowers* solitary, or sub-corymbose at the apex of a peduncle. Calyx short, campanulate or turbinate ; limb 5 lobed. Corolla campanulate, shortly 5-fid. Stamens 3 ; filaments connate into a column, rarely free ; anthers connate into a capitulum or cohering, the cells conduplicate. Rudimentary ovary 0. *Female flowers* solitary. Calyx and corolla as in the male. Rudimentary stamen 3, bifid. Fruit baccate, ovoid or ellipsoid, indehiscent. Seeds many, ovoid compressed, margined ; testa smooth or scrobiculate. Distributed to tropical Asia, tropical and south Africa ; species 13.

This genus was established as *Coccinia* by Wight and Arnott in 1834 two years prior to the publication of the genus as Cephalandra by Schrader (1836).

Coccinia indica (Naud) Wight & Arn. Prodr. 1834. p. 347 ; *Cephalandra indica* Naud. in Ann. Sc. Nat. Ser. 5, v. 16 ; Kurz. in Journ. As. Soc. 1877, pt. ii, 103 ; *Momordica monadelpha* Roxb. Fl. Ind. iii 708 ; *Bryonia grandis* Linn. f. Suppl. 126 ; Wall. Cat. 6700, except D, I, K. L ; *Bryonia*

* Dymock, W. (1885). *Materia Medica W. Ind'a*, 289
† Ainslie, W. (1826). *Materia Medica, 217*

palmata Wall. Cat. 6711 A, B, C ; Wight Ill, t. 105 ; Dene. in Jacq. Veg. Bot. t. 72 ; Hook. Ic. Pl. t. 138 ; Miq. Fl. Ind. Bat. i. pt. i. 673 ; Dalz. & Gibs. Bomb. Fl. 103 ; C. schimperi. Naud I.c. Ser. 4. xii. 16 ; *C. Wightiana* Roem. Synops. ii 93 ; Miq. I. c. 674 Rheede Hort. Mal. vii. 6, 11 ; Woodr. in Journ. Bomb. Nat. v. ii (1898) p. 640 ; Watt. Dict. Econ. Prod. v. 2, p. 252 ; *Bryonia cordifolia* Linn. Sp. Pl. (1753) p. 1012 ; *Coccinia cordifolia*, Cogniaux in DC. Monogr. Phan. v. 3. (1881) p. 529.

Vern. : Sans. *Bimba* (or *cimba*), *bimbika* ; Hind. *Bhimb. kandurikibel* or *kanduri* ; Pb. *Kanduri*, *ghol kundru* ; Beng. *Telakucha. bimba* ; Sind *Golaru*, *kanduri* ; Guj. *Phola glaru*, *goleda* ; Bomb. *Tendli*, *rantondla*, *teadali*, *bhimb* ; Mar. *Ziladi*, *tendli*, *tondali*, *bimbi* ; Tam. *Korai*, *kuo*, *kovai* ; Tel. *Donda*, *bimbika*, *kankidonda*, *kaidonda* ; Mala. *Kvelkoou* ; Kan. *Tondeballi*.

Perennial, scandent or prostrate, much branched ; root thick ; stem grooved, slender, glabrous ; tendrils slender, striate, simple. Leaves 2-4 in. long and broad, bright green above, pale beneath, studed and sometimes rough with papillae, palmately 5 nerved, from a cordate base, with globular shining glands in between the main nerves principally towards the basal side of the blade obtuse 5-angled or sometimes deeply 5-lobed, the lobes broad, obtuse or acute, epiculate, more or less sinuate toothed ; the principal teeth always ended in a specialised brown point ; petiole ¾ — 1¼ in. long. *Male flowers* : peduncles 1-flowered, ¾ — 1½ in. long, subfiliform. Calyx tube glabrous, broadly campanulate ⅛ — ¼ in. long ; teeth 1/10 in. long, linear. Corolla 1 in. long, triangular, acute staminal column glabrous ; capitulum of anthers sub-globose. *Female flowers* : peduncles ½ — 1 in. long. Staminodes 3, subulate, ⅛ in. long. Ovary fusiform, glabrous, slightly ribbed. Fruit fusiform-ellipsoid, slightly beaked, 1 — 2 by ½ — 1 in., marked when immature with white streaks, bright scarlet when fully ripe. Seeds somewhat obovoid, rounded at the apex, slightly papillose, much compressed, yellowish grey. Flowers August to September.

Habitat

Throughout India, common, sometimes cultivated. Distributed to Malaya and Africa.

The anatomical study of the leaves reveals the presence of innumerable deposit of calcium carbonate on the upper epidermal cells. These cells are completely or partially imbeded with the salt, exhibiting dotted appearance on the leaf surface. A number of small shining glands are present on the lower surface of the leaf at the basal region on the blade on both sides of the mid rib. These glands secrete sugary solution particularly through the superficial tissue into the reserve tissue which finally escapes out of the body surface. The tracheidal ends are the channels through which the liquid is carried into the gland or extranuptial nectaries [Chakravarty (1937) Physiological Anatomy of the Cucurbitaceae, *Philipp. J. Sci.* 63, (4), 111 and 112].

Medicinal and other uses

" The expressed juice of the thick tap root of this plant is used by the leading native Kavirajes as an adjunct to the metalic preparations prescribed by them in diabetes.". " The expressed juice is directed to be taken in doses of one tola along with a pill, every morning " (U.C. Dutt, *Materia Medica Hind.*). The root according to Moodeen Sheriff * is sold as a substitute for *Kabar* (*Capparis spinosa* root) in the bazars of Southern India. The leaves are of deep green colour, and are useful as a colouring agent in preparing several ointment from the essential oil. " The root when cut exudes a somewhat sticky juice, which hardens into reddish green on drying, as is very astringent, but not bitter like the fruit " (Dymock)†. The bark of the root, dried and reduced to powder, is said to act as a good cathartic, in a dose of 30 grains. The leaves mixed with ghee, are applied as a liniment to sores. The whole plant bruised and mixed with the oil of *Euphorbia neriifolia* and powdered cumin seeds, is administered by natives in special diseases. The leaves are applied externally in eruptions of the skin, and the plant internally in gonorrhoea. In the Konkan the green fruit is chewed to cure sores on the tongue (ex D.E.P).

The fruit is eaten both raw and cooked. It is eaten fresh when ripe and cooked in curries when green.

* Sheriff Moodeen (1869), *Supplement to the Pharmacopoeia of India*, 110.

† Dymock, W. (1885) *Materia Medica West India*, 351.

Occurrence

Himalaya N.W.	Tehri Garwal U. P. 30-9-01, Coll. Mackinon
Peninsular India	Kota, Rampa country Nellor Dist., Madras, 8-10-1920, Coll. V. Narayanaswami; Quilon Travancore, 17-8-13, Coll. M. Rama Rao; Courtallum Travancore, 29-11-13, Coll. M. Rama Rao; Lower Palni Hills 1,600 ft., May, Coll. Rev. G. Rodriguez; Coimbatore 1,400, 10-7-1911, Coll. C.E.C. Fischer; Mount. Nilgiri and Coorg, Coll. G. Thomson; Triplicane, Madras, February 1876; Shevaroy Hills, Salem Dist., Coll. Perrottet; Cape Comorin, Travancore, 21-10-93, Coll. M. A. Lawson; Giriki kandia 1,000 ft., 4-8-1905, Coll. C.E.C. Fischer; Mudumadugu 500 ft., Cuddapa District, February 1883, Coll. G. S. Gamble; Sriharikota, Nellore District, August 1883, Coll. J. S. Gamble; Tirukarungudi, Tinnevelly District 11th February 1913, Coll. D. Hooper & M. S. Ramaswami; Papanasam to Mundandurai, Tinnevelly District, 18th February 1913, D. Hooper & M. S. Ramaswami; Bahegaon, Chilka lake, Ganjam District 8th August, Coll. D. Hooper; Colombo 1860
Burma	Pwinbya, Minbu Dist., September 1902, Coll. Shaik Mokim; Fort Stedman Yawng-hwe, 1893, Coll. Abdul Khalil; Inle Lake, Yawng-hwe Southern Shan States, February 1917, Coll. N. Annandale; Pakokku, 19th August 1909, Coll. J. H. Lace
W. India	Badami Bijapur Dist., Bombay 1892; Andra, August 1868; Cutch, Coll. Dr. Stoliczku; Mahabaleshwar 4,500 ft., Satara Dist. Bombay 20th Sept. 1900, Coll. D. Hooper
Bengal	Agartala 500-1,000 ft., Hill Tipperah, Coll. P. M. Debbarman; Goghat Hughly District, August 1902, Coll. A. Hosain; Sundriban, August 1902, Coll. D. Prain; Sundriban 21-2-1900, Coll. Janardan; Banks of river Karnaphuli below Rangamati Chittagong District, 19th March 1899, Coll. A. T. Gage; S. Kurz; Sibpur, Coll. S. Kurz; Botanic Garden
Bihar	Singbhum 26th November 1902, Coll. H. H. Haines;
Gangetic Plain	Banda U. P. 10th May 1901, Mrs. V. S. Bell; Gangetic plain Coll. T. T.; Gorakhpur 17-6-98; Gorakhpur U. P. 11-5-98, Coll. Inyet
Laccadives Isls	Anoutta, Nov. 1891, Coll. H. M. I. M. Investigator
Malay Peninsula	Batu Gaja jungles, 17-11-1900, Coll. E. Deschampsi
Wall Cat.	Sylhet, 6700 G; H.B.C. 6700 F, 6700 B; 6700 C or E; 6700 H;
Sind	Landli Karachi 13th Aug. 1913, Coll. D. Hooper.

13. Cucurbita

Cucurbita, Linn. Gen. edit. 1, p. 297 (1737), edit. 6, p. 507. Spec. edit. 1 p. 1010, edit. 2, p. 1434 Reich. Gen. p. 504; Duch. in Lam. Encycl. meth. Bot. 2, p. 148. Juss. Gen. p. 396; Schreb. Gen. 2, p. 622; Willd. Spec. 4, p. 606; Poir. in Dict. sc. nat. 11, p. 231; Ser. in DC Prodr. 3, p. 316; Roxb. Fl. Ind. 3, p. 718; W. et Arn. Prodr. 1, p. 350; Spach. Veg. phan. 6, p. 197; Meisn. Gen. p. 127 (91); Endl. Gen. p. 928; Roem. Syn. fasc. 2, p. 16, 83; Ser. Fl. jard. et gr. cult. 2, p. 331; Miq. Fl. Ind. Bat. 1, part 1, p. 672; Naud. in Ann. sc. nat. ser. 4, v. 6, p. 5; Benth. et Hook. Gen. 1, p. 828; Hook. f. in Oliv. Fl. trop. Afr. 2, p. 555; Cogn. in Mart. Fl. Bras. fasc. 78, p. 19; Clarke in Hook. f. Fl. Brit. Ind. 2, p. 621. *Pepo* Tourn. Inst. p. 105; Adans. Fam. 2, p. 138; Moench. Meth. p. 653. *Melopepo* Tourn. l. c. p. 106. *Sphenantha* Schrad. in Linnaea, 12, p. 116; Arn. in Hook. Journ. of Bot. 3, p. 275; Wight in Ann. and Mag. of Nat. Hist. 8, p. 268; Meisn. Gen. Comm. p. 356; Roem. l. c. p. 102. *Pilocalyx*, Gaspar in Rend. del Acad. sc. di Napoli. 6, p. 409 et in Ann. sc. nat. ser. 3, v. 9, p. 220; Giorn. bot. Ital. 2 p. 212; Walp. Ann. 2 p. 617. *Tristemon*, Scheele in Linnaea, 21, 1848 p. 586.

Large climbing herbs, hispid or hairy. tendrils 2 l fid. Leaves petioled, cordate, ovate, 5 angular or lobed. The midrib of the leaf from the proximal part of the blade internally represents 9 vascular bundles arranged in an ellipse. Flowers monoecious, all solitary, yellow, very large. *Male*: calyx tube campanulate, lobes 5, linear or foliaceous; corolla campanulate, 5 lobed hardly half way down; Stamens 3, inserted in the calyx tube, anthers connate one 1 celled, two 2 celled, cells conduplicate. *Female*: calyx and corolla as in the male, ovary oblong, style short, stigmas 3, bifid; ovules very many, horizontal; placentas 3. Fruit fleshy, indehiscent, often large. Seeds ovoid or oblong, compressed margined or not. Distrib. species 5 of which 4 are cultivated, one said to be wild in Africa.

A number of small club-shaped glands are present on the lower surface of the leaves. These glands arise from the leaf surface and not from the veins their anatomical details have been studied by the author, [*Philipp J. Sci.* (1937) 63, (4), 113 and 114].

KEY TO THE SPECIES

A. Leaves rigid ; calyx tube campanulate ; segments subulate, fleshy
  B. Lobes of leaf rounded, sinuses between lobes hardly any, peduncle terete . . 1. *C. maxima*
  BB. Lobes of leaf acute, sinuses between the lobes usually deep, peduncles obtusely 5-gonal . . . . . 2. *C. Pepo*
AA. Leaves soft, calyx tube very short or none, segments foliaceous at the tips . 3. *C. moschata*

1. ***Cucurbita maxima*** Duchesne. in Lam. Dict. ii. 151 ; F.B.I. ii 622 ; Cogn. in DC. Mon. Phan. iii, 544 ; Field & Gard. Crop 55 ; Watt., Dict. Econ. Products i. 638. Naud. in Ann. Sc. Nat. Sen. 4, vi, 17.

Melon-pumpkin, squash gourd, red gourd. Vern. Beng. *Kumra* ; Hind. *Mitha kaddu, kadu* ; Bomb. *Lal-bhopali lal-dudiya* ; Kangra. *Tookm kadu* ; N. W. Him. *Garaura* ; Tam. *Pushini* ; Tel. *Gummadi* ; Mal. *Mottanga.*

Annual ; leaves with 5 shallow lobes or subentire, 4-6 in. in diam., hispidulous and also with much soft hair ; innumerable club shaped, minute glands on the lower surface of the leaf ; stems between the lobes narrow, denticulate ; hairs of the petiole equal not pungent ; petiole often nearly as long as the blade. Male peduncle 4 in. female 1½ in. ; calyx segments lanceolate linear ; corolla 3-4 in.; fruiting peduncle stout striated not grooved. Flowers March to June.

Habitat

Cultivated throughout India and distributed through cultivation in all tropical and temperate zones of the world.

Medicinal and other uses

The seeds are used medicinally ; the oil as a nervine tonic. The pulp of the fruit is often used as a poultice. "The fruit cut into small circular chips is a good application to relieve the burning of hands and feet in fevers." (Asst. Surgeon Bhagwan Dass, 2nd. Surgeon, Rawalpindi, Punjab). "The pulp is used as a poultice to boils and carbuncles" (T. Ruthnam Moodeliar, Chingleput, Madras). "Hospital Assistant Gopal Chandra Gangooli says that he has used the boiled pulp of the fruit as a poultice, for unhealthy ulcers with good effects" (Asstt. Surgeon Ananda Chandra Mukherjee, Noakhali). "The part of the fruit stalk in immediate contact with the ripe gourd, is removed and dried, and when made into paste by rubbing in water, is considered a specific for bites of venomous insects of all kinds, chiefly for that of the centipede" (Honorary Surgeon P. Kinsley, Chicacole, Ganjan). "The doses recommended is an ounce and a half beaten up with sugar. I have tried pumpkin seeds such as are sold in Calcutta as a vermifuge on one patient, a European male adult. He took 4 to 5 ounces without any effect whatever except distention of the abdomen." (Medical Examiner June, 1878 ex D.E.P).

This plant produces the largest known Cucurbitaceous fruit, in some case weighing as much as 240 lb., and measuring nearly 8 ft. in circumference. The fruit is wholesome and when young is used as a vegetable. It is sweetish and yellow, when mature it will keep for many months if hung up in an airy place. It is largely used by Indians of all classes in curry.

There are several varieties of this plant common in the gardens as a rainy season vegetable. The commonest one is a large globular gourd and of a brown colour. The young fruit resembles the vegetable marrow in flavour but the full grown fruit is very good. The seeds should be sown from April to June. The plant requires a very rich soil and the general treatment is the same as *Lagenaria vulgaris.*

Occurrence

Assam	Gauhati, March 1902, Coll. A. C. Chatterjee; Mangaldai, March 1902, Coll. A. C. Chatterjee; Dhubri, June 1902, Coll. A. C. Chatterjee.
Laccadives	Minikoy, Coll. H.M.I.M. Investigator, 1891, Dec. 5; Western Pettah 1876.
Bengal	Cultivated Royal Botanic Garden, Calcutta, June 1903.
Burma	Opposite Minbu, 8 March 1903, Coll. Aubert & Gage.
Pen. India	Chepauk Garden, Madras, 12th November 1901.

The name squash is given in America to numerous varieties of gourd which bear variously shaped fruits which go by the semipopular name *C. Melopepo*. In reality squashes come under the species *C. maxima*, several varieties of which are cultivated in America.

In the Darjeeling and Khasi Hills *Schizium edule* S.W., an extensive climber, is a common cultivated vegetable. This is a monoecious plant with perennial root stock and yellow flowers. The fruits which are pyriform with distant soft spines, grow up to 4·5 inches in length. It is locally called *quash* the name probably derived from English squash. At certain period of the season it is the most plentiful vegetable of the localities.

2. ***Cucurbita Pepo*** Linn. Sp. Pl. 1010, Roxb. Fl. Ind. iii, 718; W. & A. Prodr. 351, F.B.I. ii 612; Cogn. in DC. Mon. Phan. iii 545; DC. L' Orig. Pl. cult. 202; Field & Gard. crops ii, 58; Wall. E.D.; Naud. in Ann. Sc. Nat. Ser. 4, vi, 29; Wall. Cat. 6722.

The pumpkin, vegetable marrow; Vern.: Beng. and Hind. *Kumra, konda, kumara, kadmiah;* Bomb. *Keala;* Mar. *Kohala;* Kan. *Kumbala;* N.W.F.P. *Bhunga, petha;* Tel. *Potti gummadi.*

It is difficult to separate the vernacular names which belong to this plant with *Benincasa hispida.*

Annual. Leaves 5-lobed sinus between the lobes broad, segments 5 pointed, 4-6 in., diam., with much soft hair, hispidulous on the leaves beneath denticulate; petiole as long as the blade, the hairs on the lower surface hardened into prickles. Male peduncle 4 in. or more, female 1½ in., calyx segments 5 linear lanceolate. Corolla 3-4 in. narrow towards the base, lobes erect; fruiting peduncle woody, grooved, and marked with ridges. Flower March to June.

Habitat

Cultivated throughout India. Distributed through cultivation in all warm and temperate parts of the world.

Roxburgh included this plant (the pumpkin) as well as *Benincasa cerifera* Savi (The white melon) under one species. Aitkinson, Drury, Dutt, Moodeen Sheriff, and other writers have fallen into the same mistake. The two plants may be readily distinguished by observing the stamens: in Benincasa they are inserted near the mouth of the tube, anthers are united; in Cucurbita, the stamens are inserted below the mouth and the anthers are more or less united. The fruits of Benincasa are cylindrical, 1 – 1½ ft. covered with a waxy bloom. Anatomical evidence of the number and nature of arrangements of vascular bundles in *Cucurbita pepo* and *Benincasa cerifera* at once separates the two species. There are four vascular bundles arranged in a straight line in *B. cerifera* but in *C. pepo* seven bundles are arranged in the form of a ring in the midribs of the leaves (Chakravarty loc. cit.).

Medicinal and other uses

The seeds are supposed to possess anthelmintic properties. Atkinson, says in the Himalayan Districts, the leaves of this plant, as also of C. maxima, are used as external application for burns. "The seeds are anthelmintic and used in cases for round worms, though uncertain in action (Civil Surgeon F. H. Thomson, Monghyr). "Grubler has isolated from pumpkin seed a crystallisable variety of albumen. Hemp and castor oil seeds also contain a similar crystalline substance" (Warden, Calcutta).

The fruit is eaten in carry, cut up into small pieces and boiled with salt or fried in oil. The young tops of the tender shoots are also sometimes fried in oil or boiled in water. There are two varieties of this plant growing and used in the same way, but differing slightly one called the *bara kumra* and the other *ranga kumra.*

Occurrence

Bengal	Goghat, Hooghly Dist., March 11, 1902, Coll. J. D. Naskar
U.P.	Saharanpur, 1st May 1903, Coll. Mr. Gollan
Assam	Lakhimpur, Dhubri, June 1902, Coll. A. C. Chatterjee
Punjab	Lahore (cultivated)

3. ***Cucurbita moschata*** Duchesne, ex Poir. in Dict. Sc. Nat. xi (1818) 234 ; F.B.I. ii, 622 ; Cogn. in DC. Mon. Phan. iii. 546 ; DC. L' Orig. Pl. cult. 204 ; Fields & Gard. crops ii, 58, tt. LVIII-LXI ; Watt E.D. : *C. Melopepo* Lour Roxb. Fl. Ind. iii. 719 ; *C. maxima* Wall. ; W. & A. Prodr. 351 ; Wight Ic. 507 ; Kurz. in Journ. As. Soc. 1877. pt. ii 104 : *C. Camolenga* Wall. Cat. 6718 : Rheede Hort. Mal. viii. t. 2.

The musk Melon ; Cushaw. Crooked-necked squash Vern. N.W.P. *Sitaphal, saphari kumra, kumra, kaddu, mitha-kaddu ;* Bomb. *Kali-dudhi.*

Leaves cordate angular lobed, dentate, rugose harsely and densely pubescent on the underside ; leaf surface often marbeled with white blotches ; petiole hispid but not prickly, hairs of the petiole equal, not pungent. Fruiting peduncles angular and furrowed. Corolla campanulate broad at the base ; segments of the calyx often dilated at the apex (spathulate) into an obovate-oblong toothed foliaceous limb ; divisions of the corolla recurved. Fruit large oval spherical, glabrous, torulose. Colour of the fruit pulp yellow or orange.

Flowers March to October.

There are two primary forms one with the fruit smooth but mottled brown and yellow (*c. moschata* proper) and the other with fruit torulose or fluted with 15 to 30 ridges (*C. Melopopo* Roxb.)

Habitat

Very extensively cultivated throughout India. Distributed widely through cultivation in tropical and subtropical regions.

As stated above there are two forms of the fruit one smooth and somewhat oblong in shape the other fluted and flattened spheroidal. It seems probable that the latter (the melopepo of Roxburgh) is by many Indian writers described as *C. maxima*. The long account given by Firminger (Man. Gar. for India, 128) under the heading "*C. Melopepo*, squash" has reference to imported seed of Squash, gourd or vegetable-marrow and not to the Indian cultivated fruit, *C. moschata*. He says, in Bengal it should be sown in October but in the North-West Province not before the end of February, as the plants will not live in the cold season, of these provinces. Duthie and Fuller (in *Field and Garden crops*. Part ii, lvii to lx) give an account of *C. moschata*, but do not mention any fact regarding method of cultivation, season etc. They state that only the *Cucurbita* appears to occur in the North West Provinces. Their plates seem to represent the form Roxburgh called *M. Melopepo* and not his *C. moschata* proper.

The yellow flesh of this fruit is extensively cooked and eaten as a vegetable throughout India.

Occurrence

Assam	Lakhimpur, Sadiya Bazar, 22nd August 1909, Coll. R. K. Das ; Rotung 1,600 ft. 28-12-1911, Coll. I. H. Burkill
Bengal	cultivated, S. Kurz
Nicobar Isls	Katchall, February 1875, Coll. S. Kurz
Burma	Tonkyeghat, F. pagodas, cult ; Pegu, Oct. 1904, Coll. S. Kurz
Andaman	South Point, S. Andaman, Coll. S. Kurz
Bengal	Goghat, 11th March 1902, Coll. J. D. Naskar ; Noagaon near Ranir Bazar 600-900 ft., Hill Tipperah, June 1916 Coll. P. M. Debbarman
Central India	Indore 20-10-18, Coll. P. Mukherjee

14. Thladiantha

Thladiantha, Bunge Enum. in pl. Chin. Bor. p. 29 et in Mem. Sav. Etr. St-Petersb. 2. 1835. p. 103 ; Meisn. Gen. p. 126 (91) ; Endl. Gen. p. 940 ; Walp. Rep. v. 2. p. 205, v. 5. p. 763 ; Roem. Syn., fasc. 2. p. 19 ; Naud. in Ann. sc. nat. ser. 4, v. 12. p. 150 et ser. 5. v. 6. p. 11 ; Benth. et Hook. Gen. 1, p. 825 ; Clarke in Hook. f. Fl. Brit. Ind. 2, p. 630.

Climbing herbs ; tendrils simple rarely 2-fid. Leaves petioled, entire or tripartite, deeply cordate, denticulate, softly pubescent or nearly glabrous. Flowers dioecious, yellow, large or small. Male

peduncles in the fully developed plant paired, one 1-flowered ebracteate caducous, the other racemed ; flowers with or without bracts ; female peduncle elongate, 1-flowered, ebracteate. *Male* : calyx tube shortly campanulate, the bottom stout by a horizontal scale ; segments 5, lanceolate ; corolla campanulate, 5-partite, segments revolute about half way down ; filaments 5, inserted near the mouth of the calyx tube ; anther 1-celled, narrow oblong, straight. *Female :* calyx and corolla as in the male ; ovary oblong, style deeply 3-fid with 3 reniform stigmas ; ovules many horizontal ; placentas 3 vertical. Fruit ellipsoid, obtuse, indehiscent, green cylindric with vertical ribs. Seeds many, horizontal, small obovoid, compressed, smooth. Distrib.—Species 2, Bengal, Malaya, China.

The generic character is here widened to include the Khasia species. As in most cucurbits with paired male peduncles, either the simple or the racemed one is often wanting and the two do not flower together ; the simple peduncle generally falls off by the time the racemed one is in blossom. The corolla is slightly oblique ; in *T. calcarata* besides the normal large male flowers much smaller imperfect ones are often found.

Key to the species

A. Male racemes with prominent bract . . . . . 1. *T. calcarata*
AA. Male racemes without bracts . . . . . 2. *T. Hookeri.*

1. ***Thladiantha calcarata*** C.B. Clarke in Journ. Linn. Soc. xv (1876) 126 ; *T. dubia* Bunge Enum. Pl. Chin. Bor. 29 ; Naud. in Ann. Sc. nat. Ser. 1. xii. 105, t. 10 ; Bot. Mag. t. 5109 ; Kurz. in Journ. As. Soc. 1877, pt. ii. 102 ; *Momordica calcarata* Wall. Cat. 6740 ; *Gymnopetalum Horsfieldii* and *peperifolium* Miq. Fl. Ind. Bat. i. pt. i. 680.

A large climber. Leaves deeply cordate ovate, acute, undivided 4 by 2½ in., denticulate not at all angular, usually villous beneath sometimes nearly glabrous ; petiole 1½ in. Tendrils simple in all the wild examples, but Naudin reports of bifid tendrils in cultivated species. Male racemes 2-3 in., golden yellow, petals ¾ in. bracts prominent serrate or incise-serrate ; calyx-teeth very narrow ; filaments minutely hairy. Female peduncle 2-3 in. more or less hairy ; young ovary densely wooly. Fruit 1½ by ¾ in., glabrous, obtuse at both ends. Seeds scarsely ¼ in. Flowers March to June.

Habitat

Plains of East Bengal common, ascending to 8,000 ft., in the hills. The female plant is rare and has never been collected in plains. Pegu, Kurz ; Distrib. Malaya and China.

Occurrence

Wall. Cat. . . . . Sylhet, 6740 A ; Royal Botanic Garden Cal., 6740 B ; Goalpara, 14th May 1808 6740 C.

Bengal . . . . . E. Bengal, Pubna and neighbourhood, April 1867, Coll. S. Kurz ; Chittagong hill tracts, River bank Waga Sera hill 35 miles from Chittagong, September 1885, Coll. Badul Khan Dr. King's collector ; Chittagong hill tract, Coll. J. Wood.

Bihar . . . . . Dalsing Sarai Darbhanga, Aug. 1900, Dr. Prain's collector ; Silsaku, north side of Brahmaputra.

Assam . . . . . Gauhati, April 1902, Coll. A. C. Chatterjee ; Managaldai jungle March 1902 Coll. A. C. Chatterjee, Ligri Pukri Sibsagar, March 1895, Coll. Reporter of Economic Products to the Govt. of India ; Khasi Hills 4-5000 ft., June 1867, Coll. S. Kurz ; lower Khasi hills April 1876, Coll. S. Kurz ; Mount Khasia 0-4,000 ft., Coll. T. D.H.&T.T. ; E. Bengal ; Poishing 4,000 ft., Manipur, April 25th 1882 ; Talap-Lakhimpur 24-3-1894, Coll. G.A. Gammie Kohima 3,600 ft., Naga Hills May 1886, Coll. Dr. D. Prain ; Konoma 5,000 ft., April 1896, Coll. Dr. King's collector.

Burma . . . . . Modar plains, Tenasserim, 25-4-77, Coll. Geo. Gallatly ; Keng Tung 2,000 ft., May 1909, S. Shan States, Coll. Mac Gregor Mogok 5,000 ft., Ruby Mines Division, May 1910, Coll. A. Rodger ; Bhamo, July 1892, Coll. Abdul Huk ; between Ridge camp and Lungsia 2-3,000 ft., April 20, 1899, Coll. A. T. Gage ; Shan States 1890, Coll. Abdul Huk ; Pegu Yomah and W. Stopes 1-3-71, Coll. S. Kurz.

Sikkim . . . . . Toong 5,000 ft., 6-7-09, Coll. Smith & Cave ; Ryang valley 2,500 ft., 8th May 1874, Coll. G. King, Darjeeling 5,000 ft. Oct. 1881, Coll. J. S. Gamble ; Sikkim, Coll. G. King ; Sikkim 4-7,000 ft., Coll. J. D. H ; Rungno valley Coll. S. Kurz ; Rishap, 13th February 1867, Coll. T. Anderson ; Popore, 2,400-4,000 ft., 8-7-1862, T. Anderson.

2. ***Thladiantha Hookeri*** Clarke in Hook. F. Fl. Brit. Ind. ii. 631.

A large climber: tendrils simple. Leaves polymorphous deeply cordate ovate, acute, entire resembling altogether those of *T. calcarata* but generally less hairy and thinner, or tripartite with lanceolate segments, 4 by 1¾ in., the two lateral lobes very cordate and auricles on the outer base; petiole 2 in. The female flower in Griffith's example resembles that of *T. calcarata* but is smaller though the petals are slightly more than ½ in.; peduncle about 1 in. Male racemes 1½ in., slender; flowers pedicelled scattered, yellow petals scarcely ¼ in.; these small flowers probably correspond to the small imperfect males of *T. Hookeri* which are as yet unknown. Fruit (and seeds) altogether like those of *T. calcarata* but rather smaller, 1¼ in. The ebracteate male racemes of this with pedicles ½ in. is exceedingly unlike that of *T. calcarata*, but in all others points they appear congeneric, and the habit is the same.

Flowers May to December.

Habitat

Assam, Griffith (Kew Distrib. No. 767, 2553); Khasia alt. 4-6,000 ft.; Myrung & Nanklow H.f.&T.

Occurrence

Assam	Haflong 2,500 ft., N. Cachar, 26th Aug., Coll. W. G. Craib; Jowai, December 1893, Coll. Dr. King's collector; Cachar and Manipur frontiers 4,000 ft. May 1882, Coll. G. Watt; Mapoong 3,000 ft. 27th May 1882, Manipur Coll. G. Watt; Kala Naga Hills, May 1882, Manipur, Coll. G. Watt; Neechoogard 1,000 ft., Naga Hills 18th Oct. 1885, Coll. C. B. Clarke; Khasia 4-6,000 ft., Coll. J.D.H.&T.T.; Road to Kohima 4,500 12th May 1895, Coll. Reporter on Economic Products to the Government of India; Lushai Hills, 30th July 1924, Coll. Mrs. Parry
Burma	Kachin Hills, Upper Burma, 1897, Coll. Shaik Mokim

15. EDGARIA

Edgaria, C.B. Clarke in Journ. Linn. Soc. 15. 1876, p. 113 et in Hook. f. Fl. Brit. Ind. ii. 631.

A large scandent herb; tendrils 2-fid. Leaves petioled, entire, ovate, acute deeply cordate, more or less pubescent. Flowers large dioecious, yellow. Male peduncles paired, one 1-flowered caducous, the other racemed: bracts 0, or inconspicuous; female peduncle elongate, 1-flowered. *Male:* calyx tube, elongate, funnel shaped, teeth 5, subulate; corolla deeply 5-partite, with obovate acute segments; stamens 3, included in the calyx tube, two 2-celled; cells straight, linear oblong, connective not appendaged. *Female:* calyx and corolla as in the male: ovary narrow-obovoid, 3-celled; style long, stigma 3, oblong, 2-fid; ovules 1-3 in each cell, pendulous, compressed, subquadrate, large, corrugate or somewhat 3-lobed at the lower end and faces when dry.

Edgaria darjeelingensis C.B. Clarke in Journ. Linn. Soc. xv (1876) 133; *Gymnopetalum* sp. 5, Hook. Ind. Ori., H.f.&T.

Leaves 4 by 3½ in., serrate and denticulate; petiole 3. Male raceme 6 in., female 3-4 in. Calyx tube ¾ in. Petals ¾ in., widely patent. Fruit 3 by 1½ in. Somewhat pilose, with 2 wavy vertical ribs on each face.

Flowers May to October.

Habitat

Garwhal, Falconer; Sikkim 5,000 ft., very common, J.D.H. & C.B. Clarke

Occurrence

N.W. Himalaya . . . Sept, 1882. Simla 17500, Sept. 9877,Coll. Gamble,

Eastern Himalaya . . . Mission Compound, 4,000 ft., Kalimpong Dist., Coll. A.J.C. Kingdom ; Phadon, chee 8,000 ft., 20-8-1910, Coll. W. W. Smith ; Senchal 8,500 ft., 28-8-10. Coll. W. W. Smith ; Rungno valley, 6,000 ft., May 1862, Coll. J. Anderson-North side of Senchal, 7,200 ft., August 1862, Coll. T. Anderson ; Coll. G, King ; 6,000 ft., 1881, Coll. G. King ; 12-10-68, Coll. S. Kurz ; Ghoom 3rd Mile, 13-8-13 ; Sikkim 5-7,000 ft., Coll. J.D.H. ; Mungpoo 4,000 ft., 1st Oct. 1884, Coll. C. B. Clarke ; Gassing to Ratong River 3-10-1862, Coll. T. Anderson ; Senchal 8,000 ft., Darjeeling, September 1880, Coll. G. S. Gamble ; Rungbee, Darjeeling, 13th Aug. 1869, Coll. C. B. Clarke ; Darjeeling 6,500 ft., 16th Oct. 1776, Coll. C. B. Clarke ; Goompahar 8,000 ft., Darjeeling 12th Sept. 1875 ; Darjeeling 7,000 ft., 9-9-75, Coll. G. S. Gamble ; Kurseong and about, Sept. 1943, Coll. H. L. Chakravarti.

16. Bryonopsis

Bryonopsis, Arn. in Hook. Journ. of Bot. 3, p. 274 ; Wight in Ann. and Mag. of Nat. Hist. 8, p. 267 ; Meisn. Gen. comm. p. 356 ; Endl. Gen. suppl. 2, p. 76 ; Roem Syn. fasc. 2, p. 10, 32 ; Miq. Fl. Ind. Bat. 1, part 1, p. 656 ; Naud. in Ann. sc. nat. ser. 4, v. 18, p. 193 ; Hook. f. in Oliv. Fl. trop. Afr. 2, p. 556.—Bryoniae sect. Diplocyclos Endl. Prodr. fl. Norf. p. 68.—B. sect. *Bryonopsis* Hook. f. in Benth. et Hook. Gen. 1, p. 829 (non Bl.).

Annual scaberulous scandent herbs. Tendrils 2-fid. Leaves deeply palmately 5-lobed. Flowers monoecious, the male and the female fascicled, often in the same axils. *Male flowers :* calyx tube broadly campanulate ; lobes 5, subulate. Corolla campanulate, 5-partite ; segments ovate. Stamens 3, free, inserted on the calyx tube, filaments short ; anthers cohering, one 1-celled, the others 2-celled ; cells flexuose round the broad connective, which is not produced at the apex. Pollen muriculate. Rudimentary ovary o. *Female flowers :* calyx and corolla as in the male. Staminodes 3, small. Ovary globose or ovoid, 3-placentiferous ; ovules numerous, horizontal ; style slender ; stigmas 3, papillose, deeply 2-boled. Fruit baccate, spherical or ovoid conical, pulpy, many seeded. Seeds subpyriform, very turgid, surrounded by a very thick grooved crenulate ring, on each side of which the tumid faces of the seed project.

Distrib. S. Asia, Indian and Pacific Islands, Australia ; species 2 of which *B. laciniosa* Naud. is confined to India.

Bryonopsis laciniosa Naud. l.c. Ser. VI (1886) 30. Hook. f. in Oliv. Fl. Trop. Afr. v.2, p. 556 ; Cogniaux in DC. Monogr. phan v.3, p. 477. *Bryonia laciniosa* Linn., Sp. Pl. (1753) p. 1013 ; C.B. Clarke in Hook. f. Fl. B.I. ii, p. 622 ; Garh. Cat. p. 78 ; Dalz. & Gibs. p. 101 ; Trim. Fl. ceyl. v.2. p. 254 ; Woodr. in Journ. Bomb. Nat. v. ii (1898) p. 640 ; Watt. Dict. Econ. Prod. i. p. 542 ; Roxb. Hort. Beng. 104 ; Fl. Ind. iii, 728 ; Blume Bijd. 927 ; Wall. Cat. 6699 ; W.&A. Prodr. 345 ; Miq. Fl. Ind. Bat. pt. i, 660 ; *Bryonopsis courtallensis* Arn. in Hook. Journ. Bot. iii. 274 ; *B. erythrocarpa* Naud. in Ann. Sc. Nat. Ser. 4, xviii. 194.

The Bryony ; Vern. : Hind. *Gargu-naru ;* Beng. *Mala ;* Bomb. *Kawale-che-dole ;* Mal. *Nohoemaka ;* Tel. *Lingadouda.*

Stem much branched, slender, grooved, glabrous or scabrous. Tendrils slender, striate, glabrous, 2-fid. Leaves membranous 4-6 in., generally deeply palmately 5-lobed, sinus sometimes shallow, long and about as broad, green and scabrid above, paler and smooth or nearly so beneath, deeply cordate at the base, margins sinuate, distantly denticulate, sometimes subserrate ; petioles 1-3 in. long, striate, slender. *Male flowers* in small fascicles of 3-6 ; peduncles $\frac{1}{8}$-$\frac{3}{4}$ in. long, filiform, glabrous. Calyx glabrous $\frac{1}{10}$ in. long ; teeth subulate, less than $\frac{1}{20}$ in. long. Corolla $\frac{1}{8}$-$\frac{1}{6}$ in. long ; segments ovate-oblong, acute, pubescent. *Female flowers* solitary or few, or many ; peduncles shorter, than in the males. Fruit often 2-3 together, subsessile $\frac{1}{2}$-1 in. in diam., globose, smooth bluish-green streaked with broad vertical lines. Seeds with a thickened corrugate margin, often with protuberences on the faces, $\frac{1}{6}$-$\frac{1}{4}$ in. long, yellow-brown.

Flowers August to November.

Habitat

From Himalaya to Ceylon. Pegu, Kurz. Distributed to tropical Africa, Mauritius, Malaya, Australia.

Medicinal and other uses

"The whole plant is collected when in fruit for medicinal use. It is bitter and aperient, and is considered to have tonic properties" (Dymock*). It is also used as a medicine by the Santals. The leaves are boiled and eaten as greens.

Occurrence

Calcutta Botanic Garden	Wild, 21-10-58
Malay Peninsula	Mt. Malabar 4,700 ft., Java. Oct. 19, 1861, Coll. T. Anderson M. D.; Java; Tjilaki Preanjee 4,700 ft., 4-3-1880, Coll. H.O.Forbes
Assam	E. Bengal, Herb. Griffith; E. Sylhet
Wall. sheets	6769 C; Goalpara, Assam 8th August 1808, 6699; 6699 F; 6699 A; H.B.C. 6699 H.
Central India	Guna, Isagarh Dist., September 1867, Coll. G. King M.B. and Coll. Dr. Barkley 1876; Abu Sirohi, Rajputana; Sagor, Vicary
Bihar	Hazaribagh 1,500 ft., Chota Nagpur, Nov. 1886, Coll. G. Gamble
Himalayan N. W.	Lambatach 7-8,000 ft., Tehri Garhwal U. P. 2-6-94, Coll. J. F. Duthie; Northern India; Mussooree Range 1869, Coll. G. King; near Mussooree Debra Dun Dist., U.P. 1869 Coll. G. King
Burma	Keng Tung 4,000 ft., S. Shan States, December 1909, Coll. Capt. R. W. Mac Gregor, M. S.; Taunggyi, Yawnghwe State Upper Burma 1894, Coll. Abdul Khalil, Mooyet 5,000 ft., Tenaseerim 27-1-1887, Coll. Geo. Gallatly
Peninsular India	Poona, August 1892; Alagai Hills, 1,100 ft., Madura District, Madras S. India, 9-11-1911, Coll. C. E.C. Fischer; Machur Road 5,500 ft., Madras, 1-8-12, Coll. Rev. St. Munch S. J.; Koni, Travancore 24-8-1913, Coll. C. C. Calder & M. S. Ramaswami; Koni, Travancore 6th September 1903, Coll. M. Rama Rao; Quilon, Travancore 21-9-13, Coll. Rama Rao's collector, Shevaroy Hills, Salem Dist., Madras, collection Perrottet; Gaidmalam 3,200 ft., Coimbatore Dist., 20-8-05, Coll. C. E. C. Fischer; Mont. Nilgiri and Coorg region Coll. G. J.; Gudalur Ghat, Nilgiri, 9th January 1903, Coll. C. A. Barber; Culhatty 5,000 ft., Nilgiris 26th March 1870, Coll. C. B. Clarke; Alagar Hills 1,100 ft., Madura District, 9-11-1911 Coll. C. E. C. Fischer; Perumal Road 5,500 ft., Madras, 4-2-1913, Coll. Rev. Aug. Saulieres; Nilgiri, August 1852, Herb. Wight; Naterikal 4,000 ft., Tinnevelly District 13th February, 1913, Coll. D. Hooper & M. S. Ramaswami
Bengal	Agartala 800-1,000 ft., Hill Tipperah 30-9-14, Coll. P. M. Debbarman; Agartala 600-800 ft., Hill Tipperah Sept. 1915, Coll. P. M. Debbarman; Hoshenpore, Mymensing Nov. 1868, Coll. C. B. Clarke; Sibpur, April 1865, Coll. S. Kurz; Bengal. Rejioo. trop. Coll. J. D. H. & T. T.; Beliaghata near Calcutta. April 1943, Coll. H. L. Chakravarti
Bihar	Ranchi 2,000 ft., Chota Nagpur, 13th Oct. 1873, Coll. C. B. Clarke; Thakurganj, Purnea District, 27th January 1911, Coll. J. H. Barkill; Ganja Mahal February 1893, Coll. D. Prain; Raikote 2,000 ft., Lohardaga, Chota Nagpur, 30th Oct. 1882, Coll. C. B. Clarke
Upper Gangetic Plain	Banda, U.P., Hedges uplands, 16-12-1900 Coll. Mrs. A. S. Bell, Vern.—Pachgurria, seshrgi
N.W. Himalaya	Chamba Punjab, August 1880, Coll. Comm. Robert Ellis, Afghanistan. Badghis. April 29th, 1885, Coll. J. E. T. Aitchison
Malay Peninsula	W. Java, Coll. S. Kurz

17. Melothria

Melothria Linn. Hort. Cliff. p. 490 (1737), Gen. ed. 2, p. 20, ed. 6, p. 24, Spec. ed. 1, p. 35, ed. 2, p. 49; Juss. Gen. p. 395; Schreb. Gen. 1, p. 32; Lour. Fl. Cochinch. 1, p. 35; Willd. Spec. 1, p. 189; Nutt. Gen. 2, p. 228; Ser. in DC. Prodr. 3, p. 313; Spach. Veg. phan. 6, p. 225; Meisn. Gen. p. 127 (91); Endl. Gen. p. 936; Torr. et Gr. Fl N. Amer. 1. p. 540; Roem. Syn. fasc. 2, p. 9, 27; Benth.

*Dymock, W. (1885). *Materia Medica West. Ind.* 346.

in Hook. Niger Fl. p. 367 ; Naud. in Ann. sc. nat. ser. 4, v. 12, p. 148 ; v. 16, p. 168, v. 18 p. 195 ; Benth. Fl. Austral. 3, p. 320 ; Benth. et Hook. Gen. 1, p. 830 ; Hook. f. in Oliv. Fl. trop. Afr. 2, p. 562 ; Cogn. in Mart. Fl. Bras. fasc. 78, p. 25 ; Clarke in Hook. f. Fl. Brit. Ind. 2, p. 625. *Solena*, Lour. Fl. Coch. p. 514 (1790), ed. Willd. p. 629 ; Ser. in DC. Prodr. 3, p. 306 ; Roem. l.c.p.11, 33 ; *Zehneria*, Endl. Prodr. fl. Nor. p. 69 (1833).

Slender scandent or prostrate herbs, annual or with a perennial root, monoecious or very rarely dioecious. Tendrils simple or rarely 2-fid. Leaves usually membranous, entire or more or less lobed. Flowers small, yellow or white. *Male flowers* racemose or corymbose, less commonly fasicled or solitary. Calyx campanulate, 5-toothed. Corolla deeply 5-partite ; segments entire. Stamens 3, inserted on the tube (rarely at the base) of the calyx ; filaments free ; anthers free or rarely slightly cohering, one 1-celled, the cells straight rarely curved, the connective sometimes produced. Rudimentary ovary, globose or annular, rarely 3-lobed. *Female flowers* solitary, fascicled or corymbose. Calyx and corolla as in the male. Staminodes 3 or 0. Ovary ovoid, globose or fusiform, 3-placentiferous, constricted beneath the flower ; ovules usually numerous horizontal ; style short, surrounded at the base by an annular disk ; stigma 3 linear, rarely 2 or stigma 3-lobed. Fruit small, baccate, globose, ovoid or fusiform, usually many seeded. Seeds ovoid or ellipsoid, compressed, usually margined. Smooth or rarely scorbiculate. Distrib. Warmer regions of the globe ; species 54 of which 11 occurring in India.

Key to the species

A. Flowers monoecious
  B. Male flowers fascicled
    C. Seeds smooth on their faces ; leaves hispid beneath with long soft hair ; cordate at the base . . . . . 1. *M. leiosperma*
    CC. Seeds scorbiculate ; leaves very scabrous rough, hispid beneath, cordate at the base . . . . . 2. *M. maderaspatana*
    CCC. Seeds scorbiculate ; leaves more or less amplexicaule . . 3. *M. amplexicaulis*
  BB. Male flowers subumbellate at the apex of the peduncle
    C. Fruit globose . . . . . 4. *M. perpusilla*
    CC. Fruit ellipsoid . . . . . 5. *M. mucronata*
  BBB. Flowers frequently monoecious on the same axis sometimes apparently dioecious. Male flowers with long pedicles, clustered in the axils or clustered on long racemes resembling branches with outleaves . . . .
    C. Fruit globose, subquadrate, obtuse
      D. Male pedicles clustered in the axils . . . . 6. *M. indica*
      DD. Male pedicles in distant clusters on long racemes . 7. *M. odorata*
    C.C Fruit fusiform, subtrigonus
      D. Male pedicles clustered in the axils . . . . 8. *M. zeylanica*
      DD. Male peduncle racemed . . . . . 9. *M. Wallichii*
      DDD. Male inflorescence elongate . . . . . 10. *M. bicirrhosa*
  AA. Flowers dioecious . . . . . 11. *M. heterophylla*

1. ***Melothria leiosperma*** (W.&A.) Cogniaux, in DC. Monogr. Phan. v. 3 (1881) p. 622 ; Jackson, in Index Kew. v. 3, p. 203 ; *Mukia leiosperma* Wight in Ann. Mag. Nat. Hist. v. 8 (1842) p. 268 ; C. B. Clarke, in Hook. f. Fl. B.I. v.2, p. 623 ; Trin. Fl. Ceyl. v. 2. p. 255 ; *Bryonia leiosperma* W. & A. Prodr. 345 ; *B. mysorensis* Miq. in Herb. Hohenach.

Monoecious ; stems hispid, furrowed slightly branched ; young parts densely and softly villous hairy. Tendrils simple. Leaves 2-3½ by 1¾-3 in., bright green above, paler beneath, broadly ovate in outline, acute, cordate at the base, scabrid and coarsely hairy above, softly villous beneath, usually 5-angled or slightly 3-5-lobed, strongly dentate ; petioles ½-2 in. long, densely hairy. Flowers axillary. Male flowers fascicled ; peduncles very short. Calyx densely hairy ; tube ⅛ in. long, campanulate ; teeth linear subulate, ⅛-⅙ in. long. Corolla pubescent outside ; segments ovate oblong ⅛ in. long. Anthers subsessile, oblong, the connective short, apiculate. Female flowers : peduncles usually solitary ¾-2 in. long, thickened in fruit, densely clothed with long hairs. Ovary densely hairy. Fruit ½ in. in diam., globose, glabrous or slightly hairy. Seeds ellipsoid ⅛ by ⅛ by 1/12 in., turgid, conspicuously margined, smooth on the faces

Flowers May to December.

Habitat

Deccan Peninsula; Pulney Mts., Wight; Nilgiris G. Thomson, Hohenacker. Ceylon; alt. 4,000-5,000 ft., Thwaites.

Occurrence

Peninsular India & Ceylon .	Poombari, Pulneys 5th June 1898, Coll. A. G. Bourne; Pariakanal, 5,000 ft., Travancore December 1910 Coll. A. Meebold; Kavunji 6,300 ft., Upper Plains, 21-9-1911, Coll. C. E. C. Fischer; Shembaganur 6,000 ft., 8-7-12, Coll. Rev. St. Munch S.J.; Perumal Road 5,500 ft., 4-12-1913, Coll. Rev. Ang. Saulieres; Coonoor 5,000 ft., May 1885, Coll. J. S. Gamble.

2. ***Melothria maderaspatana*** (L.) Cogniaux. in DC. Monor. Phan. v. 3, (1881) p. 623; Jackson in Index Kew, v. 3, p. 203; *Mukia scabrella*, Arn. in Hook. Journ. Botany, v. 3 (1841) p. 276; C.B. Clarke in Hook. f. Fl. B.I. v. 2, p. 623; Dalz. and Gibs. Bomb. Fl. p. 100; Ait. Pb. & Sind. Pl. p. 64; Trim. Fl. Ceyl. v.2, p. 254; Woodr. in Journ. Bomb. Bat. v. 11 (1898) p. 640; Watt. Dict. Econ. Prod. v. 5, p. 287. *Bryonia maderaspatana* and *althaeoides*, DC. l. c. 306; *Karavia javanica* Miq. l. c. 661; *Trichosanthes dioica* Wall. Cat. 6692 C.

Annual, monoecious; stems scandent or prostrate slender, much branched, angular, very hispid young part densely covered with white hair. Tendrils simple striate, sparingly hirsute. Leaves variable in size, 1-5 by 1-4 in., deltoid-ovate, entire, 5-angled, or 3-5 lobed, very scabrid above, scabrid or shortly hispid beneath, acute at the apex, cordate at the base with a wide sinus, the lobes often overlapping, the margins dentate or subserrate; petioled $\frac{1}{4}$-1 in. long, hairy. *Male flowers* in small fascicled on very short peduncles. Calyx hairy; tube $\frac{1}{12}$ in. long, narrowly campanulate; teeth about $\frac{1}{16}$ in. long, subulate. Corolla pubescent; segments ovate-oblong, rounded at the apex, $\frac{1}{12}$ in. long. *Female flowers* almost sessile. Fruit the size of pea, smooth or slightly echinulate, at first green and variegated with yellow, finally woody red. Seed ellipsoid, compressed, not or scarcely margined, scorbiculate on both faces.

Flowers August to October.

Habitat

Throughout India common; ascending the hills as far as the subtropical region. Distributed: Africa, Mulaya and Australia.

Occurrence

Java	Batavia Oct. 1879, Coll. G. King; Java. 1859, Coll. T. Horsfield M.D.
Wall. Cat.	6708 C or G; Goalpara 25th Sept. 1868, 6708 E; Sukanagar 6th August 1880, 6708 E; Prome hills 15th Sept. 6708 F; H.B.C. 6708 H; 6708 L; Rangoon 1826; 6703; Pegu 11-1-75, Coll. S. Kurz; Rangoon, Coll. R. Scott; Pegu Yomah Coll. S. Kurz
Peninsular India & Ceylon .	Naduvettumuri 26-8-1913, Travancore State, Coll. C. C. Calder & M. S. Ramaswami; Shevaroy hills, S. India collection Perrottet; Nilgiri hills, Coll. Mr. Schmidt.; Sigur ghat 5,000 ft., Nilgiri Dist., June 1884, Coll. G.S. Gamble; Carwar, N. Canara, August 1883, Coll. W. A. Talbot; Malabar Concon Coll. Stocks; Sind. Coll. Stocks; Rajkot; Belgaum, September Coll. Ritchie; Ceylon very abundant upto an elevation of 3,000 ft.; Kavalay Cochin 2,000 ft., Nov. 1910, Coll. A. Meebold; Gudalur 5,000 ft., Nilgiris, Oct. 1910, Coll. A. Meebold; Cherretggyam 1,500 ft., Cochin Nov., 1910, Coll. A. Meebold; Guijagudem, Godavari District, 13th August 1914, Coll. M. S. Ramaswami M.A.
Burma	Mree Hill, Maymyo 3,600 ft., Sept. 12th, 1915, Coll. A. Rodger I.F.S.; Maymyo plateau alt. 3,500 ft., 6th October 1908, Coll. J. H. Lace; Keng Tung 400 S. Shan, December 1909, Coll. Capt. R. W. McGregor I.M.S.; Minbu, Sept. 1902, Coll. Shaik Mokim; Upper Burma 23rd June 1890, Coll. Abdul Huk; Tyankse, Upper Burma, 10th March, Coll. Dr. King's collector; Tagunyi, Southern Shan States, Upper Burma, 1893, Coll. Abdul Khalil

Bengal	Hazarikhil, Chittagong, 11-10-05, Coll. D. Hooper; Siliguri; Sibpur Sept. 1864, Coll. S. Kurz; Anand, Kaira Dist. 2nd Nov. 1902, Coll. Reporter Econ. Product. Govt. of India; Agartala 600-800 ft., August 1915, Coll. P. M. Debbarman
E. Himalaya	Sikkim Himalaya, 2,000 ft., 3-7-1876, Coll. G. King
Assam	Goalpara, Chairang Duars plains, December 1890, Coll. Dr. King's collector; Mont. Khasia 0-4,000 ft., Coll. J. D. H. & T.T.; Shillong, November 1890, Coll. Robertson
N. W. Himalaya	Dwarahat 4,500 Almora Dist., 7th Oct. 1912, Coll. D. Hooper; Kobo, Abor Expedition 15-12-1911, Coll. I. H. Burkill; Baligan near Naga Hills, October 1898, Coll. Dr. King's collector
Bihar	Chota Nagpur, Coll. Dr. J. J. Wood; Pareshnath Nov. 1891, Coll. D. Prain; Hundrugagh, Chota Nagpur, Sept. 1896, Coll. D. Prain; Muzaffarpur, February 27, 1896, Coll. D. Prain
Central India	Khandwa 3-12-88, Coll. J. F. Duthie
Gangetic Plain	Tropical region 1,000 ft., Coll. T.T.; Trunk Road 9-58, Coll. T.T.; near Etawah near Bundelkhand 24-11-86, Coll. J.J. Duthie; Banda N.W.P., vern. Bankakri August 1902, Coll. Mrs. A. S. Bell; N. W. India, Hb. Royle.

3. ***Melothria amplexicaulis*** Cogn. Monogr. Phan. DC. Candolle, vol. ii, p. 621; *Bryonia amplexicaulis* Lam. Encycl. meth. Bot. i, p. 496; Ser. in DC. Prodr. 3, p. 306; W. & Arn. Prodr. 1, p. 346; Wight Ic. pl. Ind. or 2, tab. 502; *B. umbellata* Wall ! List. n. 6705, K-L; *Kaviria amplexicaulis* Arn ! in Hook. Journ. of Bot. 3, p. 275; Roem. p. Syn. Fasc. 2, p. 46; Miq. Fl. Ind. Bat. 1, part 1, p. 661.

Monoecious; stems glabrous; tendrils simple; leaves on very short petioles, or almost sessile, deeply cordate or segittate at the basal lobes much longer than the petiole, ovate or oblong, entire or angled, mucronate, sinuate and toothed, dotted and slightly scabrous on the upper side, glabrous or smooth on the under somewhat coriaceous. *Male flowers* in an umbell at the apex of a slender peduncle rather shorter than the leaves; pedicles short, without bracteoles; calyx campanulate; *females* solitary, very short peduncled, in the same or different axils from the males; berry (smaller than a hazel-nut) broadly ovate, prostrate, few (about 4)—seeded; seeds oval, thick compressed, surrounded with a thick easky closely wasted and rugose zone, the sides flattish, sprinkled with little tubercles.

Habitat

Eastern India (Wight n. 1121 in herb. Brux., Berol.; DC., Deless, Francav., Mus. par. Kew., Edin., n. 1128 in herb. hort. Petrop., Kew n. 1130 in herb. Kew.; Rottler in herb. hort. Petrop; Jacquemont n. 701 in herb. mus par.); in Mysore and Carnatic (Thomson in herb. Berol. Mus. par. Vindob.); in Deccan & Ellora (Ralph. n. 301 in herb. Delss.); at Madras (Thomson in herb. Kew.).

4. ***Melothria perpusilla*** Cogniaux in DC. Monogr. Phan. v. 3 (1881), p. 607; Jackson in Index Kew., v. 3, p. 203; *Bryonia perpusilla* Blume. Bijdr. p. 926; *Zehneria Hookeriana*, Ann. in Hook. Journ. Bot. v. 3 (1841) p. 275; C.B. Clarke in Hook. f. Fl. B. I. V. 2, p. 624; Trim. Fl. Ceyl. v. 2, p. 256; *Bryonia mysorensis* Wight. Icon. t. 758 (not of Wall); Dalz. & Gibs. p. 101; *Zehneria Baueriana* Woodr. in Journ. Bomb. Nat. v. 11 (1898) p. 640; Kurz. in Journ. As. Soc. 1877, pt. ii. 105; *Zehneria exasperata* Miq. Fl. Ind. Bat. i. pt. i. 656; *Zehneria scabra* Harv. & Sond. Fl. cap. ii. 486; *Bryonia Hookeriana* W.& A. Prodr. 345; *B. cissioides* Wall. Cat. 6698; *B. oxyphylla* Wall. Cat. 6697 (no flowers).

Monoecious, climbing; root an oblong flattened tuber; stems deeply striate, glabrous. Tendrils simple, striate, glabrous. Leaves broadly ovate in outline, 1¾-3½ in. long and as broad or sometimes broader than long, acute or shortly acuminate and mucronate at the apex, usually 5 angled, the angles at the base rounded, the margins distantly toothed, the upper side usually rough with scabrous spots, the lower side smooth and prominently veined, base subcordate or nearly truncate; petiole ¾-1 in. long. *Male flowers* 3-4 at the apex of a peduncle ¾-1¾ in. long capitate or in the subumbellate racemes; pedicles short, filiform. Calyx tube $\frac{1}{10}$-⅛ in. long, campanulate, rounded at the base; teeth very short recurved. Corolla pale yellow; segments ¾ in. long, ovate oblong, subacute slightly hairy within the throat. Filaments hairy. *Female flowers* solitary or rarely subumbellate;

peduncles $\frac{1}{4}$-$\frac{1}{3}$ in. long, in the same axils as the males. Ovary globose. Fruit smooth globose minutely pitted, red when ripe, $\frac{3}{8}$-$\frac{1}{2}$ in. in diam. Seeds many much flattened smooth.

Flowers August to December.

Habitat

North Bengal; common in Sikkim, Assam, Shakia and Cachar ascending to an elevation of 5,000 ft.; Deccan Peninsula and Ceylon common: apparently always in the lower hills. Distributed to Ava, Malaya, Africa.

Medicinal use

Root is taken with milk in fever and diarrhoea (J. J. Wood, Plants of Chota Nagpur, p. 106).

Occurrence

Peninsular India	Kavurji 6,300 ft., Upper plains 21-9-1911, Coll. C. E. C. Fischer; Ooty 7,000 ft. Nilgiris, Coll. C. B. Clarke October; Long valley, Nilgiri Hills 1878, Coll. G. King; Ootacamund 12th August 1878, Coll. G. King; Coonoor 7,000 ft., Nilgiris, 7th March 1870, Coll. C. B. Clarke; Nilgiri Hills, Coll. Schmidt., Sothamkadu 4,000 ft., 21-10-05, Coll. C. E. C. Fischer; Brahmagiris 4,500-5,000 ft., 6-12-1907, Coll. C. E. C. Fischer; Devicolam 6,000 ft. Travancore, Coll. A. Meebold; Bellaji Shola 5,000 ft., 27-8-05, Coll. C. E. C. Fischer; Naterikal 4,000 ft., Tinnevelly District, 13th February 1913, Coll. D. Hooper and M. S. Ramaswami
Burma	S. Shan States, Coll. Capt. R. W. Macgregor, I.M.S., Moolyet 5,000 ft., Tenasserim, 19-2-1877, Coll. Geo Gallatly
E. Himalaya	Sikkim, November, Coll. T. Thomson; Sikkim Himalaya 4,000 ft., 28-10-1872, Coll. J. S. Gamble; Rishap 3,500 ft., Darjeeling 31st Oct. 1870; Mungop 4,000 ft., Sikkim 2nd Oct. 1884, Coll. C. B. Clarke
Bengal	Barul, Chittagong Hill Tracts, 7-3-76, Coll. L. L. Lister
Assam	Theria 150 ft., Khasia 10th Oct. 1886, Coll. C. B. Clarke
Wall. Cat.	Nopolea 1821, 6698; Sylhet H. B. 6697
Peninsular India	Malabar Konkan, Coll. Stocks;
Ceylon	in Central Province at an elevation of 2,000-4,000 ft., Coll. Thwaites;
Assam	Kalek 3,600 ft., Abor Expedition 29-12-11, Coll. I. H. Burkill; Haflong 2,500 ft., N. Cachar, 17th August 1908, Coll. W. G. Craib; Mont. Khasia 0-4,000 ft., Coll. J. D. H. & T. T.; Kohima Naga Hills, Dec. 1866, Coll. Dr. D. Prain;
Burma	Inle Lake Southern Shan States, 27th February 1917, Coll. N. Annandale; Hotha, Yunnan Expedition, 20-8-1868, Coll. D. T. Anderson
E. Himalaya	Sikkim, 3-6,000 ft., Coll. J. D. H.; Sikkim 4th Nov. Coll. T. Thomson

5. ***Melothria mucronata*** (Bl.) Cogn. in DC. Monogr. Phan. iii. 608; *Zehneria Baueriana* C. B. Clarke; F. B. I. II 624; *Bryonia mysorensis* W.&A. Prodr. 345; Wt. Icon. t. 1609 (but not dioecious) Dalz. & Gibs. Bomb. Fl. 101; *Zehneria mucronata* Miq. Fl. Ind. Bat. i. pt. 656; *Bryonia mucronata* Blume. Bijid. 923 ? *Bryonia filiformis* Roxb. Fl. Ind. III. 727; *Karivia samoensis* A. Gray in Seem. Fl. Viti 103.

A rather slender climber, nearly glabrous. Leaves cordate acute simple or 3-5-lobed half way down, 2 in. diam. generally abruptly denticulate, petiole longer than the auricles $\frac{3}{4}$-3 in. or short. Flowers frequently monoecious in the same axils sometimes apparently dioecious; male peduncle usually 1-2 in. female less than $\frac{1}{2}$ in. undivided in all the Indian examples, but occasionally the female peduncle is elongate umbellate according to Wight. Fruit when dry reticulate rugose ellipsoid, seeds much compressed. Roxburghs *Bryonia filiformis* perhaps belongs to this species but the ripe fruit is said to be nearly 1 inch. It has been referred to *Melothria indica*, but the inflorescence is quite unlike, as are the yellow flowers and stamens of Roxburgh's.

Habitat

Deccan Peninsula; Nilgiris; Canara; Belgaum. Distributed to Malaya, Japan Norfolk Island, Feejees; but the area cannot be separated from that of the previous species

Medicinal use

Root is taken with milk in fever and for diarrhoea (J. J. Wood's Plants of Chota Nagpur, p. 106).

Occurrence

North Bengal . . . . Common in Sikkim, Assam, Shasia, and Cachar, ascending to 5,000 ft.

6. ***Melothria indica*** Lour. Fl. Cochinch. 35 ; DC. Prodr. iii. 313 ; Naud. in Ann. Sc. Nat. Ser. 4, xvi. 160. with a fig. ; Kurz. in Journ. As. Soc. 1877, pt. ii. 105 ; *M. Regelii* Naud. l. c. ser. 5, v. 35 ; *Aechmandra indica* Arn. in Hook. Journ. Bot. iii. 274 ; Miq. Fl. Ind. Bat. i. pt. i. 658 ; *Bryonia tenella* Roxb. Fl. Ind. iii. 725 ; Clarke in Hook. f. Fl. Brit. Ind. vol. ii. p. 626.

A slender stemed biennial or perennial creeper. Root fibrous, white rather fleshy. Stem and branches numerous, filiform, creeping, pretty smooth. Leaves $1\frac{1}{2}$ by $1\frac{1}{2}$ in., petioled, acuminate or scarcely acute often punctate on both surfaces ; particularly underneath more or less cordate from 3 to 5-angled denticulate, petiole 1 in. Tendrils simple. Flowers axillary, two male and one female together, each on its prominent peduncle, small pure white. Pedicles of males and females about as long as the petioles. Point of the connective short. Filaments 3, from the bottom of the bell of the corolla or calyx, each with a large fleshy lid on each side of which is a single anther crested behind with a tuft of orange coloured hairs. Style filiform. Stigma large, three lobed. Fruit white when ripe $\frac{1}{2}$ in. ellipsoid pointed, many seeded. Seeds strongly margined. This appears exceedingly rare in India ; but it may be doubted whether the next species is a form of this.

Flowers August to October.

Habitat

Sikkim, alt. 3,000 ft. ; C. B. Clarke ; Sylhet in the jheels, H. f.&T. Chittagong, Kurz. A native of China. Distributed from Malaya to the Philippines, China and Japan.

Occurrence

Burma . . . . . Kung Tung 4,000, S. Shan States, December 1909, Coll. R. W. MacGregor, I.M.S.

Bengal . . . . . Kamhara, E. Mymensing, 5th November 1868, Coll. C. B. Clarke ; Chittagong Aug. 1869, Coll. S. Kurz

Himalaya . . . . Sikkim 3,500 ft., 8-9-75, Coll. G. King ; Rungbee, Sikkim Himalaya 11-8-76, Coll. G. King ; Sikkim 1873, Coll. G. King ; Sikkim 2-10-68, Coll. S. Kurz

Assam . . . . . Konoma, Naga Hills 1886, Coll. Dr. D. Prain ; Jotsome, Naga Hills, September 1886, Coll. D. Prain ; Neechoogard 500 ft., Naga Hills, 17th October 1885, Coll. C. B. Clarke

Malay Peninsula . . . W. Java Fall, S. Kurz ; Sulangora August 18th, 1880 Coll. Dr. King's collector.

7. ***Melothria odorata*** Hk. f. & Thoms. ex C. B. Clarke in Hook. f. Fl. Brit. India ii 626 ; *Melothria leucocarpa* Cogn. l. c. 601 ; *Bryonia odorata* Ham. in Wall. Cat. 6706 A.B.C.

Nearly glabrous, stem often stouter than *M. indica* ; tendrils simple. Leaves 2-3 by $1\frac{1}{2}$-$2\frac{1}{2}$ in. more or less cordate entire or somewhat 3-lobed, acute often punctate on both surfaces. petiole 1-$1\frac{1}{2}$ in. Male peduncle long somewhat zigzag, with a cluster of pedicles (each $\frac{1}{2}$-$\frac{3}{4}$ in.) at each angle ; female pedicle as long as the petiole. Corolla white, with much hair round the throat. Connective not much produced ; rudiments of ovary in the male flowers globose depressed. Seeds $\frac{1}{8}$-$\frac{1}{6}$ in. not or very obscurely margined. This species has been separated from *M. indica* by the long raceme of the male flowers, which, however, does not essentially differ. The fruit appears very obtuse, the degree of margination of the seeds can hardly be relied upon.

Flowers August to December.

Habitat

North-West Himalaya ; Royle ; throughout the plains of E. Bengal common, and ascending the hills of 7,000 ft.

Var. triloba : lobes of leaf divericating sometimes very narrow and long, petiole often shorter than the type. *Bryonia triflora* Wall. Cat. 6707.—E. Bengal, Surma Bank, Griffith (Kew Distrib. No. 2530). The male inflorescence and the fruit are like those of *M. odorata ;* the leaves unlike.

Occurrence

Assam	Jaboca near Naga Hills, December 1898, Coll. Dr. Prain's collector
Wall. Cat.	Nepal 1821, 6706 C ; Goalpara 21st August 1808, 6706 A ; Sylhet 6706 B
N. W. Himalaya	Mussooree 4-5,000 ft., September 1877, Coll. J.F.D.
Bengal	Dacca station, 11th Oct. 1868, Coll. C. B. Clarke.
N. W. Himalaya	Lohba 6,500 ft., Garhwal District, 19th October 1912, Coll. D. Hooper
Sikkim Himalaya	Teesta 1,000 ft., Sikkim 23rd October 1869, Coll. C. B. Clarke
Assam	Kohima 5,000 ft., Naga Hills, 1st November 1885, Coll. C. B. Clarke ; Pippenia 20-1-1882, Coll. H. Collect ; Khasia, Herb. Griffith ; Gauhati, November 1852 ; banks of Kulling, October 1809 ; Sibsagar, October ;
Nicobars	Battimal March 1891, Coll. Dr. Prain
Malay Peninsula	Mount Tancubam Prew, Java, 4-7,000 ft., Coll. T. Anderson

8. ***Melothria zeylanica*** Clarke in Hook. f. Fl. Brit. India. ii. 626 ; *M. deltoidea* Thwaites Enum. 124 ; *Aechmandra deltiodea* Arn. in Hook. Journ. Bot. iii. 274 : *Bryonia deltoidea* Arn. Pugil 19.

A pretty very slender climber, nearly glabrous. Tendrils simple. Leaves 2 by 1½ in. not lobed little cordate, acute often punctate on both surfaces ; petiole 1 in. Pedicles of both male and females about as long as the petioles. Corolla hairy round the throat ; rudimentary ovary of the male depressed globose. Ovary fusiform ; stigma large, 3-lobed. Fruit ½ in. broad, obtusely trigonus, almost rostrate. Seeds ⅛ in., packed in three columns. The name *M. deltoidea* is preoccupied by Benth. in *Flora Nigrit.* 368 for a different plant.

Flowers December to July.

Habitat

Ceylon ; common upto 5,000 ft., Walker ; Gardner.

Occurrence

Peninsular India & Ceylong	Ceylong 5,000 ft., 12-4-59 ; Ceylong to E.P. 16-4-59 ; Devala 3,000 ft., Nilgiris 1884, Coll. J. S. Gamble ; Kadamporai, Anaimalai Hills, 3,300 ft., Nilgiris 1884, 8-12-1913, Coll. C.E.C. Fischer ; Machur, Pulney Dist., 4th July 1897, Coll. A. G. Bourne
W. India	Savantvadi, Bombay, 3rd April 1900, Coll. Dr. Dalgado

9. ***Melothria Wallichii*** Clarke in Hook. f. Fl. Ind. ii. 626 ; *Bryonia odorata* Wall. Cat. 6706 D.

Stem glabrous, tendrils simple. Leaves triangular, not lobed little cordate, sinous scarcely denticulate, scabrous above with flat round glands, slightly hispid beneath. Male raceme nearly as in *M. odorata.* Fruit pedicle ¾ in. Fruit rostrate, attenuate at the base, resembling closely that of *M. zeylanica* but rather larger. Seeds nearly ¼ in., larger than those of *M. zeylanica* but rather larger. Seeds nearly ¼ in., larger than those of *M. zeylanica*, many, oblong very complanate, hardly margined, smooth on the faces.

Habitat

Prome (Burma) ; Wallich.

10. ***Melothria bicirrhosa*** C. B. Clarke in Hook. f. Fl. Brit. Ind. Vol. ii. page 627.

Nearly glabrous ; stem like that of *M. odorata.* Tendrils stout all 2-fid ; leaves 4 by 3 in., deeply cordate, ovate caudate acuminate, petiole 2-3 in. Inflorescence exactly as in *M. odorata.* Male flower altogether of the genus, anthers lateral on the connective which is long produced above them ; rudiment of the ovary depressed globose. Fruit not known. This appears as an excessively developed, *M. odorata.*

Habitat

Burma . . . . . Griffith (Kew Distrib. No. 2522).

11. ***Melothria heterophylla*** Cogn. in DC. Monogr. Phan. v. 3, (1881) p. 618 ; Jackson, in Index Kew. v. 3, p. 203 ; *Bryonia umbellata* Klein. in Willd. sp. Pl. v. 4, p. 618 ; Grah. Cat. p. 78 ; Dalz. & Gibs. p. 101 ; *Zehneria umbellata* Thwaites 125 ; C. B. Clarke in Hook. f. Fl. Brit. Ind. vol. ii. p. 625 ; Kurz. in Journ. As. Soc. 1877, pt. ii 105 ; *Zehneria hastata* Miq. Fl. Ind. Bat. v. 1, part 1, p. 656 ; Woodr. in Journ. Bomb. Nat. v. ii (1898) p. 640 ; Watt. Dict. Econ. Prod. v. 6 part 4. p. 355 ; *Karivia umbellata* Arn. in Hook. Journ. Bot. iii 275 ; Miq. 1. c. 661 ; *K. Rheedii* Roem. ; Miq. 1. c. 661 ; *Momordica umbellata* Roxb. Fl. Ind. iii, 710 ; *Bryonia amplexicaulis* Lamk. Dict. i. 496 ; DC. 1. c. 306 ; W.& A. Prodr. 346 ; *B. sagittata* Rheedei and Blume ; DC. 1. c. 305, 306.

Vern. Hind. *Anant-mul ;* Beng. *Kudari ;* Pb. *Bankakra.*

Dioecious ; root perennial, consisting of several tubers ; stems slender, branched, furrowed glabrous. Tendrils simple. Leaves 3-6 in. long, polymorphous, regularly ovate, or 3-5 angled or lobed, or hastate, acute or acuminate, usually cordate at the base, generally scabrid and pale green above, paler or cinereous and reticulately veined beneath, margins remotely denticulate ; petiole $\frac{1}{4}$-$\frac{1}{8}$ in. long pubescent. *Male flowers* subumbellate, 15-20 on a peduncle $\frac{1}{4}$-$\frac{3}{4}$ in. long ; pedicles filiform, $\frac{1}{8}$-$\frac{1}{3}$ in. long. Calyx glabrous ; tube campanulate, rounded at the base, $\frac{1}{6}$-$\frac{1}{4}$ in. long ; teeth minute, subulate. Corolla small, yellowish-white ; segments triangular, acute $\frac{1}{16}$ in. long. Filaments slender subglabrous, $\frac{1}{8}$ in. long. *Female flowers* : peduncles solitary, $\frac{1}{4}$-$\frac{1}{2}$ in. long. Ovary narrowly oblong, glabrous or more or less pubescent, 10-ribbed. Fruit $1\frac{1}{2}$-2 in. long, oblong ovoid cylindric, tapering towards the apex, ribbed, bright-red when ripe. Seeds obovoid or subglobose, scarcely compressed, smooth, white. The leaves are very variable in shape.

Flowers March to July.

Habitat

Throughout India and Ceylon very common. Distributed to Malaya, China, North Australia.

Var. i. Leaves deeply 5-palmate with narrow lobes, scattered glands, young ovary densely velvety, seeds oblong slightly compressed quite smooth and rounded with no trace of a margin. *Bryonia nepalensis* Seringe in DC. Prodr. iii 307 ; Temperate Western Himalaya.

Var. ii. Leaves regularly oval, margin denticulate or crenate dentate. In Eastern India (Wight n. 1122 part ; Ritchie n. 308/2 ; Hiigel n. 2417) ; in Assam (Simouns ; Masters) ; in Sylhet (Wallich n. 6705 part) ; in Mont. Khasia (Hook. f. & T.) in Sikkim (Hook. f.) ; in East Bengal (Griffith n. 2526/1 part) ; in Ceylon (herb. Berol) ; in Java (Blume).

Var. iii. Leaves ovate, angular or lobed. *Bryonia simosa* Wall ! 1. c. in Eastern India (Wallich n. 6716 part ; Wight n. 1121 ; Royel) ; in Nilgiri Hills (Hohenacker n. 1506) ; in Mysore (Hiigel n. 435) ; in Assam (Jenkins) ; in Coromandel (Belanger n. 307) ; in Ceylon (Thwaites n. 1619 : Fraser).

Var. iv. Leaves ovate-oblong, denticulate Eastern India (Lambert ; Wallich n. 6705. R.S. 3 ; Roxburgh ; Wight n. 1129 part ; Hugel n. 2822 & 4502 ; Thomson) ; in Assam (Jenkins) ; in Ceylon (herb. Lugd.-Bat.) ; in Java (Blume).

Var v. Leaves deeply 3-5 lobed, lobes subequal, triangular or lanceolate.—*Bryonia Teedonia* Roxb. 1. c. In Eastern India (Roxb. ; Wight n. 1122 part, 1129 part ; Heyne) ; in Sikkim (Hooker f.).

Var. vi. Leaves deeply 3-5 lobed, lobes subequal, sublinear. In Eastern India (Wight n. 1122 part) ; in Nepal (Wallich n. 6705 F. part).

Var. vii. Leaves hastate, lobes entire terminal lobe oblong or triangular, basal one divergent. Northern India (Stewart) ; in Sikkim (Trentler) ; in Mount Khasia (Hook. f. & T.) ; in East Bengal (Griffith n. 1526, part) ; in Java (Horsefield ; Zolinger n. 669).

Var. viii. Leaves hastate, lobes dentate or crenulate, terminal ones oblong or triangular, basal ones divergent. In Eastern India (Roxburgh ; Royel ; Stewart) ; in Nepal (Wallich n. 6705 F. part) ; in Eastern Bengal (Griffith n. 2526, part) ; in Coromandel coast (Belanger n. 307) ; in Ceylon (Thwaites n. 1619 part).

Var. ix. Leaves hastate, lobes entire, terminal lanceolate or linear-lanceolate, basal ones parallel or convergent. *Bryonia sagittata* Bl. l. c.—*Zehneria connivens* Miq. l. c. Eastern India (Wight n. 1129 part) ; in Mount Khasia (Hook. f. & Thomson) ; in Sikkim (Hooker. f.) : in East Bengal (Griffith n. 2526, part) ; in Java (Blume ; Horsfield).

Var. x. Leaves hastate, lobes entire, terminal one lanceolate or linear lanceolate, basal ones divergent. *Bryonia Rheedii* l. c. East India (Jacuemont n. 898. A ; Ritchie) : in Tenasserim (Falconer) in Punjab (Aitchison n. 1056) ; in Mont. Khasia (Hook. f. & Thom.) : in Java (Blume & Zollinger n. 669 part).

Var. xi. Leaves hastate, lobes sublinear, lobular, lateral ones divergent. Eastern India (Hugel n. 4965 in Herb. vindol).

Var. xii. Leaves hastate, lobes sublinear, entire lateral ones divergent. In Nepal (Hornimann in herb. Berol) ; in Ceylon (Thwaites n. 3506 in herb. DC. Boiss. Mus. Par. Kew).

Medicinal use

Dymock remarks, " Its medicinal properties do not appear to be known to European writers on Indian Materia Medica, nor does it appear to have had a place in the Sanskrit Materia Medica. In Konkan the juice of the root with cumin and sugar is given in cold milk as a remedy for spermatorrhoea, and the juice of the leaves is applied to parts which have become inflamed from the application of the marking-nut juice. As a *paushtik* or restorative and fattening medicine, roasted onions, gometta root, cumin sugar and ghee are given or gometta only with milk and sugar " (*Materia Medica West Ind.*). Food : " The ripe and unripe fruits are eaten by the natives, as are also the roots when boiled " (Roxb. Campbell). In Bombay the fruit is eaten together with that of *Capparis zeylanica* Linn.

Occurrence

N. W. Himalaya . . .	Coll. P. W. Mackinnon ; Tons Valley 4-5,000 ft., Tehri Garhwal District, 4th June 1894, Coll. J. F. Duthie.
Bengal	Alipur Duars, 1891, Coll. E. A. Heawood.
Orissa	Baripada vern. Bankundi, Myurbhunj District, 30th June 1912, Coll. D. Hooper.
Burma	Mountain stream 500 ft., Upper Chindwin District, 19th October 1926 ; Inle Lake, Southern Shan States, 6th March 1917, Coll. N. Annandale ; Maymyo plateau 3,500 ft., Mandalay District, 10th May 1909, Coll. J. H. Lace ; Taba dowa, Upper Burma July 1891, Coll. Abdul Haque ; Moulmein, Tennesserim, May 1911, Coll. A. Meebold ; Keng Tung 2,000 ft., Southern Shan States, July 1909, Coll. Capt. R. W. MacGregor.
Bihar	Top of Parashnath, 23rd September 1858.
Bengal	Rich soil, Kodala Hill 30 miles from Chittagong, October 1887, Coll. Dr. King's collector, Badal Khan.
Burma	Nwamadanng Hills, Minbu District, Upper Burma, 20th March 1903, Coll. Aubert and Gage ; Fort Stedman, 1894, Coll. Abdul Khalil ; Khoni, Upper Burma, May 1888, Coll. J. C. Prazer ; Chu ku plains, Tenasserim, 27th April 1877, Coll. Geo. Gallatly ; Martaban, Coll. S. Kurz ; Toladowa, Upper Burma, July 1891, Coll. Abdul Khalil ; near Maymyo 4,000 ft., April 1888, Coll. N Manden ; Plumado, above the village 4,000 ft., April 1888, Pegu, Coll. S. Kurz ; Amherst, 30th March 1849, Coll. Falconer ; District, Memon, Myitkyina Yunan Expedition, 8th June 1868, Coll. D. J. Anderson ; Sittang side Pegu, Coll. S. Kurz.
Peninsular India and Ceylon .	Mundomurhi, Travancore State, 27th August 1913, Coll. C. C. Calder and M. S. Ramaswami ; Manuzhathora, Travancore, 4th October 1912, Coll. M. Rama Rao ; Mundagamurhi, Travancore, 27th August 1913, Coll. M. Rama Rao ; Perumal 5,500 ft., Madras, 4th February 1913, Rev. August. Saulieres ; Dachuru, Nelore District, about 250 ft., 12th August 1917, Coll. C. E. C. Fischer ; Mysore and Carnatic, Coll. G. Thomson ; Travancore, Coll. J. F. Bourdillon ; Bhimandidu, Mysore Province, 30th March 1905, Coll. C. A. Barber ; Koni, 200 ft., Travancore, 19th December 1894 ; Coll. J. F. Boudillon, Madras ; Madras Presidency, Coll. M. S. Ramaswami ; Bombay ; Gungagudem, Godavari District, 11th August 1914, Coll. M. S. Ramaswami ; Karwar, N. Kanara District, Bombay, June 15, 1883, Coll. Dr. Ritchie ; Trichur, Cochin, Madras, September 1884, Coll. J. S. Gamble ; Malabar, Konkon, tropical region, Coll. Stocks Law

Assam	Therria Ghat, Khasia and Jaintia Hills, 14th October 1910, Coll. D. Hooper; Wood north of Circuit house, Haflong, 2,500 ft., N. Cachar 1-VIII, 1908, Coll. W. G. Craib; Haflong 2,675 ft., W. Cachar, 10th August 1908, Coll. W. G. Craib, near Maoryng Kueng, 4,500 ft., Khasia Hills, 8th June 1911, Coll. I. H. Burkill, and S. C. Banerjee; Mount Khasia 1-4,000 ft., Coll. J. D. H. & T. T., Gauhati, May 1831, East Bengal; Coll. Griffith, Khasia, Coll. Oldham, Konoma, May 1895; Coll. Reporter of Economic Products of the Government of India; Kohima, 4,750 ft., Naga Hills, 22nd October 1885, Coll. C. B. Clarke; Kohima, 30th October 1885, Coll. C. B. Clarke; Khongui Hill 6,000 ft., Manipur (on the Eastern frontier of India), April 8 1882, Coll. George Watt.
Bengal	Dinajpur, March 1897, Coll. Reporter of Economic Products Government of India; Sibpur IX, 64, Coll. S. Kurz.
E. Himalaya	Lachung valley 7,500 ft., Sikkim Himalaya, 14th September 1892, Coll. Col. G. A. Gammie; Ryang, 23rd August 1876, Coll. G. King; Kalimpong 4-5,000 ft., July 18 1914, Coll. Thonton Ripley; Ryang, 2,000 ft., 12 May 1874 Coll. G. King; towards Tungbo, 20th June 1857, Sikkim Terai, Coll. S. Kurz; Sikkim 1-2,000 ft., Coll. J. D. H.; Rungo valley, Coll. S. Kurz; Mungpu—British Sikkim, August 1903, Coll. A. C. Harttess.
Central India	Ajmere, Abu Sirohi, Rajputana, June 1868, Abu 4,000 ft., Coll. G. King, M.B.; Guna, 9th August 1867, Coll. G. King; Abu, Rajputana, Coll. Major Roberts.
N. W. Himalaya	Simla, 4-7,000 ft., Coll. T. T.; Ganges valley near Muklea, 8-9,000 ft., 13th August, Coll. J. F. Duthie; Hazara, N. W. F. P., 3,500-5,000 ft., Coll. Stewart; Dippi, 8,000 ft., Coll. Dr. Brandis; N. E. of Simla, Coll. Dr. Stoliezka; N. W. India Hb. Royle, September 4th 1880, Coll. J. E. T. Aitchison.
Bihar	Sahibganj, Santal Parganas, Bihar, 22nd May 1870, Coll. C. B. Clarke.
	Parasnath Hill, Hazaribagh District, 14th November 1858.
Gangetic Plain	1,000 ft., Moradabad, U. P. 8/45, Coll. T. T.; Moharajaganj, Gorakhpur District U. P. vern. Birhani, 6th October 1902, Coll. Kalka Prosad.
Bengal	Chandernagar, August 1902, Coll. Abu Hossein; Chandpur, Tipperah, 26th October 1898, Coll. D. Hooper.
Orissa	Baripada Vern. Bau Koadrie, Maymurbhanj, 3rd December 1911, Coll. D. Hooper.
Central India	Chanda, District Chanda, Central Province, 6th February 1904, Coll. Reporter of Economic Products, Government of India.
E. Himalaya	Great Rungiet, Sikkim, 1,800 ft., May 1862, Coll. T. Anderson, M.D.; Sikkim, 1872, Coll. G. King, M.B.
Wall. Cat.	Dindigul, Madura District, Madras, 11th December 1826, Tavoy, No. 6705 S., Tavoy Burma, 28th August 1827, n. 6705 S., Sylhet, Assam, No. 6705, 6705 N., 6705 O, 6705 E or F., Gorakhpur, U. P., 6705 C, 21st April 1814, Jalpaiguri, March 1809, 6705 D.
Java Pen.	Java, Coll. Bl.

18. Kedrostis

Kedrostis, Medic. Phil. Bot. 2. p. 69 (1791). Meisn. Gen. p. 126 (91); Endl. Gen. pl. p. 935. n. 9124; Arn. in Hook. Journ. of Bot. 3. p. 273: Wight in Ann. and Mag Nat. Hist. 8. p. 267: Roem. Syn. fasc. 2, p. 8. 22: Endl. l. c. n. 9125; Roem l. c. p. 8, 23.—*Rhynchocarpa* Schrad. Reliq. l. c. (1838) 403; Endl. l. c. n. 5129; Meisn. Gen. comm. p. 356; Naud. in Ann. Sc. nat. ser. 4, v. 12, p. 146; Benth. et Hook. Gen. Pl. 1, p. 831; Harv. Gen. South Afr. Pl. edit. 2. p. 126: Boiss. Fl. Orient. 2, p. 762; Hook. f. in Oliv. Fl. trop. Afr. 2, p. 627.

Prostrate or scandent herbs: root perennial. Tendrils simple. Leaves entire or lobed. Flowers small, monœcious (rarely diœcious). Male flowers racemose or corymbose. Calyx tube campanulate, usually glabrous within; lobes 5 short. Corolla rotate, 5-partite. Stamens 3 (rarely 5), inserted in the calyx tube: filaments short, glabrous; anthers short, glabrous, one 1-celled, the others 2-celled (or when 5 all 1-celled), free or slightly cohering, the cells straight or slightly curved, the connective usually 2-fid or 2-partite: produced beyond the cells. Rudimentary ovary 0 or glandulifform. Female flowers subsessile, solitary of aggregated, shortly pedicelled. Calyx and corolla as in the male. Rudimentary stamens 0 or 3, very small. Ovary usually ovoid, beaked 2-3-placentiferous; ovules few, horizontal; style sometimes obscurely surrounded by a disk at the base: stigmas

2 or 3. Fruit baccate, ovoid, usually rostrate. Seeds usually few, tumid, margined ; testa usually crustaceous smooth. Distrib. Tropical and sub-tropical Asia and Africa ; species 11.

Kedrostis rostrata Cogniaux. in DC. Monogr. Phan. v. 3 (1881), p. 636 ; Jackon. in Index Kew. v. 2, p. 4 ; *Rhynchocarpa fœtida* C. B. Clarke in Hook. f. Fl. Brit. Ind. 2, p. 627 (partly) ; *R. rostrata* Naud. in Ann. Sc. Cat. Ser. 4, v. 16, p. 177 ; Kurz. in Journ. As. Soc. Beng. (1877), part 2, p. 105 ; Trim. Fl. ceyl. v. 2, p. 258 ; Woodr. in Journ. Bomb. Nat. v. ii (1898), p. 640 ; Watt. Dic. Econ. Prod. v. 6, part 1, p. 502 ; *Aechmadra rostrata* Arn. in Hook. Journ. Bot. v. 3 (1841), p. 274 ; Dalz. & Gibs., p. 100 ; *Bryonia pilosa* Roxb. Hort. Beng. p. 104 ; Grat. Cat. p. 248 ; *Bryonia rostrata* Rottl ; in Willd. Spec. pl. 4, p. 616 ; Ser. in DC. Prodr. 3, p. 304 ; Wight & Arn. Prodr. 1, p. 346.

Scandent, monœcious ; stems slender, branched, angled, scarcely hairy. Tendrils simple, filiform glabrous. Leaves $\frac{3}{4}$ by 2 in. long and as broad as long, membranous, orbicular in outline, bright green, hairy and more or less scabrid on both sides, margins entire or distinctly toothed, cordate at the base. Sometimes 5-angled or sublobate, the lobes subacute, apiculate ; petioles $\frac{1}{2}$-$1\frac{1}{2}$ in. long, hairy. *Male flowers :* peduncles filiform $\frac{1}{4}$-$\frac{3}{4}$ in. long, 2-4 flowered at the apex ; pedicells capillary $\frac{1}{10}$-$\frac{1}{4}$ in. long, usually bracteolate at the base ; teeth minute. Corolla pale yellow segments oblong lanceolate, acute $\frac{1}{6}$-$\frac{1}{5}$ in. long pubescent. *Female flowers :* peduncles $\frac{1}{10}$-$\frac{1}{3}$ in. long. Ovary oblong, beaked pubescent. Fruit subsessile, deep red about 1 in. long, ovoid, tapering into a long narrow beak, pubescent. Seeds $\frac{1}{6}$ in. long oboid, with a narrow sharp wing, brown.

Flowers May to October.

Habitat

Gujarat, Dalzell ; Deccan Peninsula, Rottler, Wight ; Malabar Hills, Stocks ; Dr. Ritchie ; Ava, Wallich. Distributed tropical Africa and Natal.

Medicinal use

Speaking of this plant Ainslie says, " The fruit as it appears in the bazars, is about the size of a finger and of a light grey colour ; it has no particular smell, but slightly sweetish and mucilagenous taste, it is prescribed internally, in electuary, in cases of piles ; in powder it is sometimes ordered as a demulcent in humoral-asthma ; dose of the electuary two tea spoonful thrice daily ".

Occurrence

Pen. India	Gingee, S. Arcot, District Madras, 1st October 1926, Northern Division, January 1852, Kodaikanal Ghat, Madura District, Madras ; Pulneys, 7th July 1901, Coll. Bourne ; in grass on a hill near Deverayi, 1,800 ft., July 1918, Coll. L. J. Sedgwick & T. R. D. Bell, Bodinaikanur, District Madura, December 1910, Coll. A. Meebold ; Bombay, N. Dalzell.
C. I.	Ali Rajpur, 20th May 1897, Coll. Reporter of Economic Products to the Government of India ; Vern. *Mirchaya kanda*.

19. Cerasiocarpum

Cerasiocarpum, Hook. f. in Benth. et. Hook. Gen. Plant I, p. 832 ; Baill. Dict. de Bot. 1, p. 702 ; Clarke in Hook. f. Fl. Brit. Ind. 2, p. 628.

Climbing glabrous herbs ; tendrils simple. Leaves long petiolate, oblong, cordate, nearly entire. Flowers very small, monœcious ; male peduncle carrying a few clustered flowers at the top ; female flowers sessile, solitary, often in the same axil with the male. *Male :* calyx tube short campanulate with 5-minute teeth ; corolla 5-partite ; stamens 3 ; anthers subsessile, distant, one 1-celled, two 2-celled ; cells oblong, lateral on the connective which is not produced ; rudiment of the ovary 0. *Female :* calyx and corolla as in the male ; ovary ovoid ; disc. 0, stigma 3 ; ovules 3, horizontal ; placentas vertical ; fruit ellipsoid, subsessile, indehiscent, without a beak ; seeds 2-6, smooth, slightly compressed.

Cerasiocarpum zeylanicum Hook. f. in Benth. & Hook. f. Gen. i. 831 ; Clarke in Hook. f. Fl. Brit. Ind. 2. p. 629 ; *C. Benettii* Cogn. in Monographia Phanarogamarum. Vol. III, p. 729 ; *Bryonopsis Benettii* Miq., Fl. Ind. Bat. part 1, p. 657 ; *Aechamandra zeylanica* Thw., Enum. pl. zeyl., p. 125.

Leaves 3-6 in. membranous obtuse or acute triangularly oblong or hastate, base broadly emerginate cordate, margin entire or undulate denticulate ; petiole ½-1½ in. Flowers ¼-⅓ in. diam., yellow. *Male flowers :* calyx tube, sparingly pilose, about 1 in. long and about 1-1¼ in. broad. Petals broad acuminate 5-nerved with dense glandular hairs about 1 in. long and less than an inch broad. Stamens-filaments about ⅙-¼ in. long, anthers ¼-⅜ in. long. *Female :* calyx tube campanulate, 1⅕ in. long and ¾ in. broad. Petals ovate oblong, 1⅕ in. long. Ovary glabrous about an inch long and ½ in. in diameter. Seeds ⅙-¼ in. diam., little compressed, incompletely margined, 2-6 in. each fruit.

Flowers August to November.

Habitat

Ceylon, alt. 3-5,000 ft., Thwaites ; Java ; Sumatra ; in India orient.

Occurrence

Ceylon . . . . . Central Province at an elevation of 3-5,000 ft., Coll. Thwaites ; Antani, November 1858.

Sumatra . . . . . Gœnasty nay Lampay, 12th August 1880, Coll. H. O. Forbes.

20. Corallocarpus

Corallocarpus Welw. in Benth. and Hook. Gen. Plant 1, p. 838 (1867) and Sert. Angol. in Trans. Linn. Soc. 27, p. 32 ; Hook. f. in Oliv. Fl. trop. Afr. 2, p. 565 ; Clarke in Hook. f. Fl. Brit. Ind. 2, p. 627 ; Cooke Fl. of Bombay 1901-03 vol. I, p. 543.

Prostrate or climbing herbs. Tendrils simple. Leaves roundish or cordate, lobed or palmate. Flowers minute, monoecious. Male flowers croweded at the apex of along peduncle. Calyx-tube broadly campanulate ; lobes, short. Corolla 5-partite ; segments ovate-oblong. Stamens 3, free, inserted on the calyx tube ; filaments very short, anthers glabrous, entire or partite, one 1-celled, the others 2-celled, the cells straight, the connective produced or not, often bifid. Rudimentary ovary 0 or minute. Female flowers sessile or shortly pedicelled, solitary or fascicled, sometimes subspicate. Calyx and corolla as in the male. Rudimentary stramens 0 or minute. Ovary ovoid, beaked, 2-3 celled ; ovules few, horizontal ; style straight, without a basal disk stigma 3 (rarely 2-4) lobed. Berry fleshy ovoid or ellipsoid, rostrate or obtuse, operculately dehiscent near the base. Seeds few, obovoid or subglobose, tumid. Distrib. India and Tropical Africa. Species 15.

Key to the species

Seeds globose compressed hardly margined ; fruit ellipsoid sessile, suddenly narrowed into a short back ; stem stout . . . . . 1. *C. velutinus.*

Seeds ellipsoid or pyriform ; stem slender ; Female flowers usually fascicled or subspicate ; seeds not margined . . . . . 2. *C. conocarpa.*

Female flowers usually solitary ; seeds slightly margined . . . . . 3. *C. epigaeus.*

1. ***Corallocarpus velutinus*** Benth. & Hook. f. Gen. Pl. v. 1, Fl. B. I. v. 2, p. 628 ; Woord. in Journ. Bomb. Nat. v. ii (1898). p. 640 ; Hook. Bomb. Fl. vol. i, p. 544 ; *Aechenandra velutina* Dalz. & Gibs., p. 100.

A stout climber ; root fibrous ; stem stout, angular, hairy, deeply grooved, not much branched. Tendrils very long, striate, simple. Leaves fleshy, suborbicular in outline, 2-3 in. long and as broad as long, pale green and at first softly villous, finally scabrid above, tomentose and ashy-grey beneath, cordate or subtruncate at the base, deeply palmately 3-5 lobed, the lobes rounded or oblong, sometimes tubulate, irregularly denticulate ; petiole stout, 1½-2 in. long, densely hairy. *Male flowers* in 15-20 flowered racemes at the top of a hairy slender peduncle 2-4 in. long ; pedicles filiform ⅒-⅕ in. long ; calyx shortly hairy ; tube sub-hemispheric, ⅛ in. long ; teeth narrowly triangular, less than $\frac{1}{16}$ in. long. Anthers subsessile ; connective scarcely produced, bifid. *Female flowers* fascicled, subsessile. Fruit ¾ in. long, including the beak, sessile ellipsoid, suddenly narrowed into a beak almost ½ in. long, red when ripe, finely velvety. Seeds ⅛ in. in diam., globose, margined.

Habitat

Sind, Dalzell; Distrib. Persian Gulf and tropical Africa.

Occurrence

W. India . . . . . Mihrat Tangi, 3,500 ft., Beluchistan and assigned District, Coll. J. H. Lace.

2. ***Corallocarpus conocarpus*** C. B. Clarke, in Hook. f. Fl. B. I. v. 2 (1878), p. 628; *Aechandra conocarpa* Dalz. and Gibs. Bomb. Fl., p. 100; Hook. Bomb. Fl. v. i. p. 544.

Climbing, monœcious; stems slender, striate, glabrous; tendrils simple, slender, glabrous. Leaves 2-2$\frac{3}{4}$ by 1$\frac{1}{2}$-2$\frac{1}{2}$ in. pale green above ash coloured beneath both surfaces and especially the lower, clothed with minute white hairs, scarcely scabrid, cordate, at the base, deeply palmately 3-5-lobed, the lobes oblong lanceolate, acute or acuminate, the terminal lobe the longest much contracted at the base; petioles $\frac{3}{4}$-1$\frac{1}{4}$ in. long, slender, rugulose. *Male flowers* 6-15 at the apex of a slender glabrous peduncle $\frac{1}{2}$-1$\frac{1}{4}$ in. long; pedicles filiform $\frac{1}{2}\frac{1}{4}$-$\frac{1}{12}$ in. long. *Female flowers* fascicled or subspicate. Fruit glabrous conical-oblong, not suddenly contracted into the beak, orange red except the cupshaped base which remains green. Seeds pyriform, turgid $\frac{1}{8}$-$\frac{1}{6}$ by $\frac{1}{12}$-$\frac{1}{10}$ in., dark brown (nearly black), margined.

Flowers June to August.

Habitat

Gujarat near Malpor and Gundar; Dalzell; also in Stocks collection probably from Sind. Distributed to Central Africa. W. India: Sind: Sambal, Dharwar, Bombay, September 4, 1889. Coll. W. A. Talbot.

3. ***Corallocarpus epigaeus*** C. B. Clarke, in Hook. f. Fl. B. I. v. 2 (1879), p. 628: Trin. Fl. Ceyl. v. 2, p. 258; Woodr. in Journ. Bomb. Nat. v. ii (1898) p. 641: *Bryonia epigaea* Rottl. in Nov. Act. Soc. nat. scrut. Berol 4, p. 212 (1803); Willd. spec. Pl. 4, p. 619: Spreng. syst. veget. 3, p. 16: Wight Arn. Prodr. 1, p. 346; Wight Icon. tab. 503: Walp. Report 2, p. 198; non Bl.: *B. glabra* Roxb. Hort. Beng. p. 104, Fl. Ind. 3, p. 725; *B. palmata* Wall. List n. 6711 D, non Lin.: *Aechenandra epigæa* Arn. in Hook. Journ. of Bot. 3, p. 274: Rom. Syn. mon. fasc. 2, p. 33: Thw. Enum. pl. zeyl. p. 125; Dalz. & Gibs. Bombay Fl. p. 100: *Rhynchocarpa epigaea* Naud. in Ann. Sc. nat. ser. 4, v. 16, p. 178.

Prostrate or climbing, monœcious; root large: turnip shaped: stems slender, grooved, zigzag, glabrous; tendrils simple, slender glabrous. Leaves suborbicular in outline, $\frac{3}{4}$-3 in. long, usually a little broader than long, light green above, paler beneath, shortly roughly hairy on both surfaces, deeply cordate at the base, angled or more or less deeply 3-5-lobed, the lobes usually lobulate and obtuse, sometimes apiculate more or less irregularly dentate on the margins; petioles $\frac{3}{4}$-1$\frac{1}{2}$ in. long, glabrous. *Male flowers* small, 5-15 at the apex of a straight stiff glabrous peduncle 1$\frac{1}{2}$-2$\frac{1}{2}$ in. long; pedicles filiform, $\frac{1}{2}\frac{1}{4}$-$\frac{1}{12}$ in. long. Calyx slightly hairy; tube $\frac{1}{16}$ in. long, slightly rounded at the base, teeth minute, erect, distant, subulate. Corolla greenish yellow; segments $\frac{1}{2}\frac{1}{4}$ in. long. Anthers yellow; connective green, produced beyond the cells, bifid. *Female flowers* usually solitary; peduncles short stout, glabrous. Fruit stalked $\frac{1}{2}$-1 in. long including the beak, ellipsoid or ovoid suddenly contracted into a slender beak $\frac{1}{4}$ in. long, scarlet in the middle, the base and beak green circumcisely dehiscent at the junction of the green and red portions near the base. Seeds 6-9 in. orange coloured pulp, pyriform, $\frac{1}{8}$-$\frac{1}{6}$ by $\frac{1}{12}$-$\frac{1}{10}$ in. turgid, brown, with a whitish corded margin.

Flowers June to August.

Habitat

Punjab, Rawalpindi, J. E. T. Aitchison: Sind and Gujarat, Dalz.: Deccan Peninsula, Rottler: Wight: Belgaum, Ritchie: Ceylon, Thwaites.

Medicinal use

"The root is of varying thickness and length and much resembles that of *Momordica dioica*, being in shape not unlike a badly grown turnip, but much larger: externally it is yellowish white

and marked with red circular rings ; the taste is bitter mucilaginous, and subacid when cut it exudes a viscid juice, which soon hardens into an apalescent gum " (Dymock*). A drug valued by the people of India as a alterative tonic useful in syphilitic cases. According to Ainslie† the Vydians of South India esteem the merits of this drug. They prescribe it in later stages of dysentery and old venereal complaints. It is usually administered he says " in powder, which is of very pale colour, in doses of a pagoda (about a drachm) weight in the twentyfour hours and continued for eight or ten days together ; this quantity generally produces one or two loose motions. The root when dried very much resembles the *columba root*, to which it apporoaches also in medicinal qualities ;" Ainslie also states that for external use in chronic rheumatism it is made into a liniment with cumin seed, onion, and castor oil. It is considered an anthelmintic and deobstruent, and in the Deccan and Mysore it enjoys the reputation of being a valuable remedy for snake bite, being administered internally to the bitten part. The authors of the Pharmacopœia of India agree with Ainslie that this drug deserves to be more carefully examined and its properties tested.

Occurrence

Pen. India	Coimbatore, Trichonopoly, 3rd September 1878 ; Coll. G. King, Kamalepore September 1910 ; Coll. A. Meebold, 1,000 ft., Coimbatore District ; Coll. C, E. C. Fischer, Lower Pulney, 1,500 ft., 27th September 1913 ; Coll. Rev., Aug. Sauliers, Bailur, 3,800 ft., Coimbatore District, 22nd August 1905 ; Coll. C. E. C. Fischer, Hills East of Rajampet, 1,200 ft., Cuddapah District, February 1883 ; Coll. G. S. Gamble, Malabar, Konkan, Bombay ; Coll. Stocks, Law etc.
Wall. Cat.	6711, 6709 B, 6709 A, 6709 C.
Gangetic Plain	Banda, U. P., common, 7th May 1901 ; Coll. Mrs. A. S. Bell, vern. *Indoran*, fruit poisonous. Jumna ravines near Agra, 31st December 1885 ; Coll. J. F. Duthie.
Bengal	W. Bengal ; Coll. S. Kurz.
Central India	Wasali, Buldana Ditrict, Berar, 23rd September 1909 ; Coll. I. H. Burkill, Seoni, Chanda District, Central Province, November 1902.

21. Blastania

Blastania Kotschy et Peyr. Pl. Tin. p. 15 (1865-1866), edit. Kanitz. p. 21 ; *Ctenolepis* Hook. f. sec. Naud. in Ann. Sc. Nat., ser. 5. v. 6. p. 12 (1866. non DC. Notar 1847) : *Ctenolepis* Hook. f. in Benth. and Hook. Gen. Plant. 1, p. 832 (1867) and in Oliv. Fl. trop. Afr. 2, p. 557 : Clarke in Hook. f. Fl. Brit. Ind. 2, p. 629 ; Sicyi. *Zehneriæ* and *Bryoniæ* Spec. Auct. ; *Zehneriæ* sect. *Bracteria* Stocks in Hook. Kew. Journ. of Bot. 4, p. 148.

Prostrate or scandent, annual herb. Tendrils simple. Leaves digitalely 5-7-lobed or partite. Bracts stipuliform, in axils of the leaves, toothed or pectinately cilate. Flowers minute, monœcious. *Male flowers* racemose, on slender pedicles. Calyx-tube short, campanulate ; lobes 5, subulate, very small. Corolla rotate, deeply 5-partite. Stamens 3, inserted on the calyx tube, free : filaments remote, very short ; anthers small, one 1-celled, the others 2-celled, the cells short, straight, the connective not produced. Rudimentary ovary 0. *Female flowers* solitary in the same axils as the male : peduncles short. Calyx and corolla as in the male. Staminodes 0. Ovary ovoid, 2-3 placentiferous : ovules few, horizontal : style columnar without a basal disc ; stigma 2 (rarely 3). Fruit fleshy, globose or obliquely subquardrate. Seeds few, ovoid, much compressed or boat shaped, the margins obtuse or acute ; testa smooth.

Distribution Tropical and subtropical Asia, Tropical Africa ; species 2.

Key to the species

Fruit ellipsoid or globose	1. *B. fimbristipula.*
Fruit obreniform or hammer shaped	1. *B. Garcinia.*

1. ***Blastania fimbristipula*** Kotschy. et Peyr., Pl. Tin. p. 15. tab. 7. edit. Kuitz., p. 22 : *Bryonia fimbristipula* Fenzl., in Kotschy Iter. Nutic. n. 205. 231 (1841), in flora, 1844. p. 313 :

* Dymock, W-(1885). *Materia Medica West India, 353*
† Ainslie, W-(1826). *Materia Medica* 2,158

Schweinf. Fl. Aethiop., p. 250 ; *Zehneria cerasiformis* Stocks in Hook. Kew. Journ. of Botany 4, p. 149 ; Walp. Ann. 4, p. 855 ; Dalz. and Gibs. Bomb. Fl. p. 100 ; Aitch. Pb. & Sind Pl. p. 65 ; *Ctenolepis cerasiformis* Hook. f. in Oliv. Fl. trop. Afr. 2, p. 558 ; C. B. Clarke in Hook. f. Fl. Brit. Ind. 2, p. 630.

An extensive climber ; stems subfiliform, elongate, much branched, grooved and angled, glabrous, smooth or slightly scabrid. Tendrils slender, elongate, striate, simple. Leaves membranous, 1½-4 in. long and broad, scabrid on both surfaces with white spots, usually 3-partite (rarely 5-lobed), the segment ovate oblong or lanceolate, acute narrowed at the base, denticulate or crenulate, the lateral segments more or less 2-lobbed, the intermediate segment entire or 3-lobed often with a long mucro ; petioles ¾-1½ in. long, slender grooved, hirsute, at length scabrid with white spots. Stipular bracts ¼-½ in. long, orbicular, reniform or dimidiate, scabrid with minute white spots, ciliate with hairs as long as the breadth of the bract. *Male flowers* 5-10 at the apex of a glabrous filiform peduncle ¾-1½ in. long ; pedicles ebracteate $\frac{1}{20}$-$\frac{1}{80}$ in. long. Calyx teeth minute. Corolla minute ; segments ovate-oblong, obtuse, spreading. *Female flowers* solitary ; peduncles short. Fruit subsessile, globose scarlet glabrous, ½ in. in diam. Seeds 2, ovoid, ⅓ in. long, 3/16-¼ in. broad ; smooth yellowish grey, convex on one side, deeply concave on the other edge sharp.

Habitat

Sind, Stocks ; Gujarat, Dalzell.—Distrib. Tropical and Southern Africa.

W. India . . . . . Sind, Bombay ; Coll. Stocks.

2. ***Blastania Garcini*** Cogniaux. in DC. Monogr. Pvan. v. 3 (1881) p. 629 ; Jackson. in Index Kew, v. 1, p. 311 ; *Ctenolepis Garcini*, C. B. Clarke, in Hook. f. Fl. Brit. Ind. v. 2, p. 629 ; *Byronia triloba* Lour. Fl. Cochinch. 2, p. 594, edit. Willd. 2, p. 731 (non Thunb.) ; *B. agrestis* Ræusch. Bot. edit. 3, p. 283, *B. stipulacea* Willd., Spec. 4, p. 620 (excl. var.) ; Ser. in DC. Prodr. 1, p. 344; *B. reniformis* Roxb., in E. ind. Comp. Mus. tab. 468 in ed. ex. W. Arn. ; *Zehneria Garcini* Stocks, in Hook. Kew. Journ. of Bot. 4, p. 149 ; Walp. Ann. 4, p. 855 ; Thw. Enum. pl. zey. p. 125 ; Dalz. & Gibs. Bombay Fl. p. 99 ; *Ctenolepis Garcinis* Naud. in Ann. Sc. Nat. ser. 5, v. 6, p. 13.

Climbing ; stems slender, elongate, striate, branched, glabrous. Tendrils capillary. Leaves membranous, 1-2 in. long and broad, at first hisrute afterwards scabrid with white spots, deeply 3-5-lobed, the lobes usually obovate, obtuse or acute, constricated at base, denticulate or crenately toothed, the intermediate lobes scarcely longer than the others, mucronate ; petioles ½-1½ in. long, slender, striate, shortly hirsute, at length scabrid. Stipular bracts ⅙-5/16 in. long, ovate or rotundate, shortly hairy, fringed on the margin with long filiforms cilia. *Male flowers* yellowish white, 3-4 at the apex of a slender peduncle, less than ½ in. long ; pedicles $\frac{1}{24}$-1½ in. long. *Female flowers* solitary on very short peduncles. Fruit broader than long, ⅙-¼ by ⅓-⅜ in., bright red, glabrous inversely subreniform or hammer shaped. Seeds ¼-⅓ by ⅛ in., oblong yellowish-grey, rounded at the apex, slightly attenuated at the base, with a deep pit on one face convex on the other, the edge *thick and obtuse*.

Flowers September to December.

Habitat

Bundelkhand, Edgeworth ; Deccan Peninsula, Rottler ; Ceylon Thwaites.

Medicinal use

Atkinson says that the fruit, seeds and roots are used in medicine.

Occurrence

Peninsular India . . . Northern Division, Bodinaikanur, Madura, December 1910 ; Coll. A. Meebold Ahmadnagar, Bombay, 1,800 ft., September 1919 ; Coll. L. T. Sedgwick & T. R. D. Bell, Biccavol, Godavery Delta, 24th December 1907 ; Coll. Dr. Bourns, Hills of Rajampet, 1,200 ft., Cuddapah District, Noypauvelchady, Coimbatore ; Coll. Wight.

Wall. Cat. . . . . 6712 A.

W. India . . . . . Rajkot, Kathiawar, Bombay, Surat, Bombay ; October, 1910 ; Coll. P. S. Kanetkar, Gujarat, Bombay.

Central India . . . . Guna, Isagarh District, Gwalior, September 1857.

22. Dicælospermum

Dicœlospermum C. B. Clarke in Hook. f. Fl. Brit. Ind. 2, p. 630.

A scabrid climbing slender herb. Tendrils simple. Leaves petiolate, ovate cordate or subhastate. Flowers white, minute, shortly pedicelled, monœcious, the male and the female in the same axils. Male flowers solitary or fascicled. Calyx-tube, short, campanulate; teeth 5, minute. Corolla deeply 5-partite; segments entire, triangular ovate, stamens 3, free, inserted on the calyx-tube; filaments very short; anthers oblong, one 1-celled, the others 2-celled; the cells straight, connective narrow, scarcely produced at the apex. Rudimentary ovary glanduliform. Female flowers unknown. Fruit dry, depressed globose, 1-celled. Seeds 3, erect, inserted at the bottom of the cell.

Distribution.—India (W. Peninsula), apparently endemic.

Dicœlospermum Ritchiei C. B. Clarke in Hook. f. Fl. Brit. Ind. v. 2, p. 630; Woodr. in Jour. Bomb. Nat. v. II (1898) p. 641.

Stems elongate, not much branched, grooved, scabrid. Tendrils slender, elongate, striate, sparingly hairy. Leaves $1\frac{3}{4}$-3 in. long and about as broad as long, deep green and sparingly hirsute above, paler hirsute and at length scabrid beneath, denticulate, usually ovate sub-triangular and slightly 3-lobed, the lateral lobes very short, acute, long, very scabrid (almost echinulate). *Male flowers* fascicled; peduncles filiform, $\frac{1}{10}$-$\frac{1}{8}$ in. long hairy. Calyx-tube $\frac{1}{10}$ in. long. *Female flowers* not seen. Fruit sessile, glabrous, smooth umblicate at the apex, about $\frac{1}{5}$ in. long and somewhat broader than long, red when ripe. Seeds whitish-brown, $\frac{1}{6}$ by $\frac{1}{5}$ by $\frac{1}{10}$ in., broadly ovoid, compressed, slightly beaked, longitudinally ridged and slightly rugulose in the middle, containing three cavities, the central enclosing the embryo, the 2 lateral empty.

Flowers July to September.

Habitat

Belgaum, also in Herb. Stocks, doubtless from Western India. District.—Apparently endemic. Stocks (without locality) in Herb. Kew; Konkan: W. Ghats near Matteran. Woodrow. Deccan S. M. country; Belgaum, Ritchie.

None of the specimens have female flowers, they have been collected in the fruiting condition.

Occurrence

W. India . . . . Amboyne, 12 miles south of Lensli, Poona, October 1897; near Lansli, October 1897; Coll. G. M. Woodrow, Poona.

23. Cyclanthera

Cyclanthera, Schrad. Index Sem. Hort. Gotting, 1831, Linnæa, 8, Litt. p. 23 et Reliq. in Linnæa. 12, p. 408; Messn. Gen. Plant., p. 127 (92); Spach. Veg. phan. 6, p. 222; wndl. Gen. Plant n. 5143; Arn. in Hook. Journ. of Bot. 3, p. 280; Rœem. Syn. fasc. 2, p. 101; Naud. in Ann. sc. Nat. Ser. 4, v. 12, p. 158; Ser. 5, v. 6, p. 15; Benth. and Hook Gen. plant 1. p. 836; Cogn. Diagn. Cucurb. fasc. 2, p. 61 and in Mart. Fl. Bras. fasc. 78, p. 101.

Flowers monœcious. Male racemose or paniculate. Calyx tube pateriform or cupular, 5-dentate, subulate or filiform occasionally 0. Corolla rotate deeply 5-partite, segments broadly ovate oblong, often acute. Stamens united in a central column, filaments short: anthers top connate, loculus linear conduplicate or longitudinally dehiscent, or occasionally anthers horizontal annular unilocular circular dehiscent pollen ovoid, when dry, 4-5 furrowed globose when moist, apertures as many as the longitudinal furrows. Pistillode 0. Female flowers in the axil of the male flowers solitary. Calyx and corolla as in the male. Staminodes 0. ovary oblique, ovoid, rostrate. 1-3 locular or 2-many locular, occasionally trilocular, locules 2 septate with one ovule in each cell. Style stout stigma large, hemispherical. Ovules many when the ovary 1-2 celled and solitary when the ovary is multicellular, erect or oblique, ascending. Fruit oblique, ovoid gibbous and reniform, scarcely fleshy, prickly or spiny, rarely smooth. One to multilocular, 5 to many seeded, sprouting dehiscence, leaving a naked central or lateral placentiferous column. Seeds plain, angular, testa crustaceous smooth or rough, apex often bifid or bicuspidate.

A tropical or temperate American herb, scandent, glabrous or subglabrous, root annual or perennial. Leaves entire or lobed or pedate, 3-13 foliate. Tendrils simple or 2-many fid. Flowers often minute, yellowish green or white, sometime 6-merous.

Cyclanthera pedata Schrad. Index Sem. hort. Gothing. anno. 1831.

Stem glabrous; leaves pedate 5-7-foliate; leaflets sessile of subsessile, lanceolate or oblong-lanceolate, narrowed at base, apex acute or subobtuse and mucronate, denticulate or subcrenulate; tendrils 3-4-fid; male flowers small, in panicles semi-verticilate inflorescence, branches with many flowers; calyx denticulate with bristles, minute; fruit subsessile, sparcely spinous or smooth rostrate at the apex acute recurved.

Schrad. in Linnæa, 8, p. 23 and v. 12, p. 408; Spach. Veg. phan. 6, p. 223; Walp. Repert. 5, p. 761; Roem. syn. fasc. 2, p. 101; Naud. in Ann. sc. Nat. Ser. 4, v. 12, p. 159; the Garden 12 (1877), p. 617 Cun. icone; Cogn. Diagn. Cucurb. fasc. p. 63.

Stem scandent, sufficiently robust, long, much branched, angular, smooth. Petiole robust, channeled, glabrous 5-15 cm. long. Leaves upper surface bright green; lower surface pale green, both sides punctate-scabrous more so on the upper surface; terminal leaflets 7-16 cm. long, 2-6 cm. broad; lateral ones somewhat small, outmost ones very deeply 2-3-lobed. Tendrils robust, elongate, channeled, glabrous. Common peduncles of the male flowers slender, angularly furrowed, glabrous smooth, 10-20 cm. long, 25-50 flowers; branches short, distant; pedicles filiform, spreading, fasciculate, subglabrous, tube 3-4 mm. long, teeth spreading, occasionally slightly flexuous, $\frac{1}{4}$-$\frac{3}{4}$ mm. long. Corolla golden yellow, segments broadly ovate triangular, acute 3-sub-5-nerved, both sides shortly sparingly pubescent glandular, $1\frac{1}{2}$-2 mm. long, 2-$2\frac{1}{2}$ mm. broad, apex papillose. Female peduncle 1-3 mm. long, calyx and corolla as in the male, somewhat larger. Ovary oblique oblong, narrowed at the apex and rostrate; style thick $\frac{1}{2}$-$\frac{3}{4}$ mm. long, stigma subloculate, 2 mm. broad. Fruit smooth gibbous, oblong, base narrow, occasionally sparingly echiniate. Green when young white when mature, bilocular 8-10 seeded, 5-7 cm. long, $2\frac{1}{2}$-3 cm. broad. Seeds subquadrate base truncate, apex appendicular, margin muricate. 10-12 mm. long, 7-8 mm. broad and 2 mm. thick.

Flowers about the end of October.

Habitat

N. W. Himalaya . . . Jeolikota, 4,000 ft., Kumaon, 22nd October 1912, Coll. N. Gill.

24. Actinostemma

Actinostemma Griff. Pl. Cantor., p. 24, tab. 3; Lindl. Veg. Kingd., p. 315; Endl. Gen. Plant Sullp. 5, p. 50; Griff. Notul. 4, 601; Naud. in Ann. Sc. Nat. Ser. 5, v. 5, p. 39; Benth. and Hook. Gen. Plant 1, p. 838; C. B. Clarke in Hook. f. Fl. Brit. Ind. 2, p. 632; *Mitrosicyos*, Maxim. Prin. Fl. Amus., p. 112 (1834) and in Ann. Sc. Nat. Sr. 4, v. 13, p. 95; *Pomasteriom* Miq. in Ann. Mus. hedg. Bat. 2, p. 80 (1865) and Prol. Fl. Jap., p. 12; Bull. Soc. bot. detr. 13, Revul., p. 8.

A slender climbing herb; tendrils simple, 2-fid. Leaves petioled, deeply cordate or hastate, elongate, much toothed, nearly glabrous. Flowers small, monoecious, in lax axillary panicles, pedicles jointed about their middle; panicles frequently male with a few females near the base. *Male:* calyx rotate 5-partite, with lanceolate linear segments; corolla 5-partite, segments lanceolate caudate; stamens 5, free; connective dilated-papillose on one side, with a narrow straight oblong anther-cell on the other. *Female:* calyx and corolla as in the male; ovary subglobose, verrucose, 1-celled; style short, with 2 reniform stigmas; ovules 2-4, pedulous, subparietal, capsule ovoid conical half superior, covered with rough points, circumscise above the middle. Seeds 2-4, compressed, ovate, corrugated and denticulate on the margin.

Species 4 of which only one is found in India.

Actinostema tenerum Griff. Pl. cantor 25; Clarke in Hook. f. Fl. Brit. Ind. p. 633 (exel syn.); *Sicyos axycanthos* Wall. Cat. n. 6683; *Momordica Paina* Wall. Cat. n. 6742; *Mitrosicyos lobatus* Maxim. in Prin. Fl. Amur. 112, t. VII; *Pomasterion japonicum* Miq. Ann. Mus. Lugd. Bat. ii 80.

Leaves 4 by $2\frac{1}{2}$ in. acute, scarcely lobed in the Bengal specimens, palmately lobed in Maximowicz, petiole often 2 in. Panicles 2-6 in. fruit $\frac{3}{4}$ by $\frac{1}{2}$ in. not at all trigonas, upper part muricated as well as the lower. Seeds $\frac{1}{2}$ by $\frac{3}{8}$ in.

Habitat

Plain of E. Bengal, frequent Assam (Sylhet). Distrib. Amurland, Japan.

25. Zanonia

Zanonia Linn. Coroll., p. 19, Gen. ed. 2, p. 477, ed. 6, p. 523. Spec. ed. 1, p. 1028, ed. 2, p. 1457 (non Blum.); Reich. Gen., p. 519; Juss. Gen., p. 397; Neck Elem. 1. p. 1244; Schreb. Gen. 2, p. 690; Willd. Spec. 4, p. 769; A. St.-Hib. Mem. Mus. 9, p. 218; Bl. Bijdr., p. 937; Ser. in DC. Prodr. 3, p. 298; Poir. in Dict. Sc. Nat. 59, p. 254; W. and Arn. Prod. 1, p. 340; Meisn. Gen., p. 126 (91); Spach. Veg. Phan. 6, p. 189; Endl. Gen., p. 934; Arn. in Hook. Journ. of Bot. 3, p. 272; Rœm. Syn. fasc. 2, p. 113, 117; Miq. Fl. Ind. Bat. 1, Part 1, p. 682; Benth. & Hook. Gen. 1. p. 839; Clarke in Hook. f. Fl. Brit. Ind. 2, p. 633.

Scandent glabrous or pubescent shrubs. Tendrils simple or bifid. Leaves petiolate, ovate or entire. Flowers dicœcious, all racemose or the males panicled. *Male flowers:* sepals 3, broadly oblong or orbicular, membranous concave. Corolla rotate 5-partite, coriaceous or fleshy; the segments narrowed at the apex. Stamens 5, free inserted on a fleshy disk; filaments very short and thick; anthers transversely oblong, adnate to the filaments 1-celled. Rudimentary ovary 0. *Female flowers:* calyx and corolla as in the male. Staminodes very short, alternate with the petals. Ovary, elongate at first 3-celled, at length 1-celled by the absorption of the septa; ovules 2-many in each cell, attached at both sides to parietal placentas, pendulous. Fruit cylindric, clavate or hemispheric terete or subtrigonous, truncate and broadly 3-valved at the apex. Seeds large pendulous oblong, compressed imbricate, surrounded by a large membranous wing. Distrib.—Tropical Asia, Java, Species 2.

Zanonia indica Linn. sp. Pl. ed. 2 (1763), p. 1457; Willd. Spec. 4, p. 769; Poir. in Lam. Encycl. meth. Bot. 8, p. 837, I. 11 des gen. 3, p. 407, tab. 816; Bl. Bijdr., p. 937; Ser. in DC. *Prodr.* 3, p. 298; Spach. Veg. phan. 6, p. 189; Rœm. Syn. Fasc. 2, p. 117; Wight & Arn. *Prodr.* 1, p. 340; Wight, I. 11. tab. 103; Miq. Fl. Ind. Bat. 1, part 1, p. 682; Thw. Enum., p. 124, 442; Clarke in Hook. f. Fl. Brit. Ind. 1, p. 633; Watt. Dict. Econ. Prod. v. 6, part 4, p. 322; Cogn. in Mongr. Phan. De. Candolle vol. iii, p. 926; Cook. Flora Presi. Bombay, Vol. I, p. 546.

Scandent, climbing to a height of 30-50 ft. Stems stout, cylindric, striate, woody, glabrous. Tendrils elongate, terete, glabrous. Leaves coriaceous, deciduous (leaving a permanent circular scar) 3-6 by 2-4 in. ovate-oblong, acute entire bright green and glabrous above, paler and conspicuously reticulate beneath, 3-nerved from a rounded or slightly cordate base; petiole $\frac{5}{8}$-$1\frac{1}{4}$ in. long, stout, glabrous. *Male flowers* in racemes or panicles 6-12 in. long; on slender grooved glabrous peduncles; pedicles somewhat stout, articulated about the middle, $\frac{1}{12}$-$\frac{1}{6}$ in. long, bracteolate at the base. Sepals $\frac{1}{12}$ in. long, ovate acute, concave glabrous. Petals greenish-yellow, oblong, obtuse $\frac{1}{6}$ in. long, $\frac{1}{12}$ in. broad at the base. *Female flowers* in 5-12 flowered recemes 4-12 in. long. Sepals broadly triangular, $\frac{1}{6}$ in. long. Petals ovate oblong $\frac{1}{4}$-$\frac{1}{3}$ in. long. Ovary cylindric, $\frac{1}{2}$ in. long. Capsule shaped like a candle extinguished 4-2 in. long, cylindric obconic, slightly tapering towards a rounded base, truncate at the apex, glabrous pale yellowish brown. Seeds much compressed, $\frac{3}{4}$ by $\frac{3}{8}$ in., pale yellow, smooth, the wing 2-$2\frac{1}{2}$ in. long by $\frac{1}{2}$ in. broad, rounded at the base and apex, fruit ripe in May.

Flowers January to October.

Habitat

Assam and East Bengal Griffith: Deccan Peninsula Wight; Malabar Mts. Stocks: Law, Dalzell; Ceylon not uncommon up to 2,000 ft. Thwaites. Distrib. Malaya.

Medicinal use

According to Rheede the leaves beaten up with butter milk, are used in South India as an anodyne application. The Sinhalese value the plant as a febrifuge (Thwaites*). The fruit is said to possess acrid cathartic properties. The Hakims in Bombay assert that the fresh juice is very

* Thwaites, G. H. K. (1859). *Enumeretio Plantarum Zeylanicum 124*

efficacious as an antidote to the venomous bites of the Gecko, known in the Deccan as Shal-i-alam or "king of the world" (S. Arjun*). In Malabar a bath made by boiling the leaves in water is used to remove the nervous irritation caused by boils, and an antispasmodic liniment is made by pounding the leaves with milk and butter.

Occurrence

Malaya Peninsula	Kinta Perak, 300 ft., January 1885; Coll. H. Kunstler, G. Borbo, 300-500 ft., March 1885; Dr. King's collector, banks of B. P. river, 300-400 ft., August 1885; Coll. Dr. King's collector.
Andamans	North Bay Hill Jungu, S. Andaman, 29th October 1892; Coll. Dr. King's collector.
Peninsular India	Tenmalai Travancore State, 11th September 1913; Coll. C. C. Calder and M. S. Ramaswami, Kaldumtti, Travancore, 11th September 1913; Coll. Rama Rao, Travancore, Coll. M. A. Lowson, Tiagli, 2,000 ft., N. Kanara District, Bombay, 1896; Coll. W. Talbot.
Ceylon	Central Province.
Bengal	Royal Botanic Garden, Calcutta.
Assam	E. Bengal; Herb. Griffith.

26. Gomphogyne

Gomphogyne Griff. Pl. Cantor, p. 26. adnot. 4; Endl. Gen. Pl. Suppl. 5, p. 50; Benth. and Hook. Gen. Plant. 1, p. 838; C. B. Clarke in Hook. f. Fl. Brit. Ind. 2, p. 632; *Triceros* Griff. not pl. Asiat. 4, p. 606 (non Lour).—*Zanoniae* and *Alsomitrae* Spec. Auct.

Climbing weak, succulent herbs, tendrils 2-fid or simple. Leaves petioled, pedate, with 5-7 lanceolate, serrate leaflets. Flowers small, monoecious (sometimes at least), male racemed; females panicled or clustered. *Male:* calyx rotate, 5-partite, with oblong segments; corolla 5-partite with elongate lanceolate segments; stamens 5, filaments united at the base; anthers globose, 1-celled straight. *Female:* calyx produced above the ovary and the corolla as in the male; corolla segments caudate; ovary top-shaped, 1-celled; style 3, 2-fid. at the wide truncate summit, crowned by the persistent styles. Seeds 3 (2-1), ellipsoid, little compressed, black, obscurely margined. Distrib. Species 2, one in the Himalaya and the other in Burma.

Key to the species

Capsule succulent; seeds oblong	1. *G. Cissiformis.*
Capsule dry; seeds ovoid	2. *G. heterospermum.*

1. ***Gomphogyne cissiformis*** Griff. Pl. Cantor., p. 26, adnot., tab. 4; C. B. Clarke in Hook. f. Fl. Brit. Ind. 2, p. 632.

Leaves 2½ in. diam., glabrous or slightly pubescent, apex acute or acuminate, base long attenuate, margin crenate dentate. *Male* racemes 1-6 in., simple or more often appearing compound towards the end of the leafless branches, provided with minute bractiolates. Calyx segments acute about $\frac{1}{10}$ in. long. Petals glabrous, trinerved margin obscurely denticulate $\frac{1}{6}$ in. long. *Female* clustered near the axils or on panicles 2-4 in. bracts subulate, elongate. Capsule somewhat succulent ½ in. wide at the summit, seed ¼ in. oblong with scaly tubercles on the rounded faces.

Flowers about October.

Habitat

Garhwal alt. 750 ft., Madden; Kumaon 7,000 ft., Edgeworth, Strachy and Winter bottom; Sikkim 5,000-7,000 ft, Lachoong J. D. H.; Doobdi C. B. Clarke.

Var. glabra Cogn. Fruiting inflorescence slender, with long pedicle; fruit glabrous.

Var. villosa Cogn. Fruiting inflorescence stout, aggregated, with short pedicles; fruit tomentose. Sikkim in Lachoong cum var. (Hook. f. in herb Kew. Par. Vindob. Lugd.-Bat.).

*Arjun, S. (1879). *Catalogue of Bombay Drugs*, 260

Occurrence

N. W. Himalaya	Jumna valley between Rana and Banos in dampwoods, 8-9,000 ft., October 1899.
Sikkim	Doobdi, 6,000 ft., 10th October 1875 ; Coll. C. B. Clarke, Sikkim ; Coll. S. Kurz., Darjeeling, 7,000 ft., October 1880 ; Coll. G. S. Gamble, Sikkim, 5-7,000 ft. ; Coll. J. D. H., Dumsong, 6,000 ft., Darjeeling, December.
Java	S. Kurz.

2. ***Gomphogyne heterosperma*** Kurz. in Journ. As. Soc. Beng. 40, 1871 ; 11.58 Clarke in Hook. f. Fl. Brit. Ind. 2, p. 632 ; *Zanonia ? heterosperma* Wall. Listn. 3728 et Pl. Asiat. var. 2, 29 ; G. Don., Gen. Syst. 3, p. 4 ; Walp. Repert. 2, p. 194 ; Miq. Fl. Ind. Bat. 1, part 1, 683. *Alsomitra heterosperma* Rœm. Syn. fasc. 2, p. 118.

Leaves and inflorescence closely resemble *G. cissiformis*, capsule dry gribbed, $\frac{1}{2}$ in. narrow linear oblong, $\frac{1}{3}$ in. at the summit, seeds $\frac{1}{8}$ in. ovoid rugose-lacunose.

Habitat

Burma : Taong Dong. Wallich.

27. Gymnostemma

Gymnostemma Bl. Bijdr., p. 23 (1825) ; Linnæa. 1, p. 497 ; Spreng. Cur. post, p. 246 ; Meisn. Gen., p. 5 (7) ; Spach. Veg. phan. 8, p. 7 ; Endl. Gen. Pl. p. 827 ; Dcne. in Arch. du Mus. 1, p. 147, adnot ; Rœm. syn. fasc. 2. p. 21 : Miq. Ind. Bat. 1. part 2, p. 687 ; Benth. and Hook. Gen. pl. 1, Fl. 839 ; C. B. Clarke in Hook. f. Fl. Brit. Ind. 2, p. 633 ; *Pestalozzia*, Zoll in Morr. Syst. verz. Zoll Plf., p. 31 ; Walp. Ann. 1, p. 316 ; Endl. Gen. Pl. suppl. 5, p. 50 ; *Enkylia* Griff. & Pl. Cantor., p. 26 ; Endl. Gen. Pl. suppl. 5, p. 50.

Climbing herb ; tendrils simple. Leaves pedate ; leaflets 3-5, ovate lanceolate, serrate, membranous. Flowers small, dicœcious, in axillary diffuse panicles, greenish. Male calyx short, with 5 small lobes ; corolla rotate, 5-partite, with lanceolate segments ; stamens 5, filaments connate below ; anthers 2-celled ; cells long, straight. Female calyx and corolla as in the male ; ovary spherical 3 2-celled ; style 3-2 united at the base, at the apex 2-fid ; ovules in each cell 2, pendulous. Fruit globose, size of a pea, indehiscent, 1-3-seeded. Seeds not winged, verrucose, submuricate.

Key to the species

Leaflets (3-5) mostly glabrous beneath or slightly pubescent—3-5-foliate ; leaflets membranous . . . . . 1. *G. pedata.*

Leaflets (3) densely pubescent, more so on the veins ; leaflets not membranous . 2. *G. barmanica.*

1. ***Gymnostemma pedata*** Blume. Bijd. ; Miq. Fl. Ind. Bat. i, pat. 687 ; *Enkylia digyna* and *trigyna*, Griff. Pl. Contor. 27 ; *Zanonia Wightiana* Arn. in Hook. Journ. Bot. ii, 272 ; *Z. cissoides* and *laxa*, Wall. Pl. As. Par. ii, 28, 29 ; Wall Cat. 3726, 3727 ; *Z. pedata*, Miq. Fl. Bat. i. pt. i. 683 ; *Pestalozzia pedata* Zoll. et Morr. Syst. Verz. 31 ; Enum 124. *G. cissiodes*, *pedata* and *Wightiana*, Bth. & Hook. f. Gen. Pl. i, 839.

Stem glabrous or pubescent. Leaflets mostly 5 or 3, $1\frac{1}{2}$-2 in. lanceolate or ovate lanceolate ; generally glabrous or slightly pubescent on both surfaces more or less membranous, ovate oblong or lanceolate ; margin undulate or acuminate, leaf base attenuate ; petiole 1-$1\frac{1}{2}$ in., often pubescent with a line of crisped hairs. Panicles usually 3-6 in. sometimes 15 in. by nearly a foot broad, leafless ; bracteoles subulate $\frac{1}{20}$ in. long. Petals one-nerved, margin denticulate, when dry gives the appearance of a bird's claw, $\frac{1}{10}$-$\frac{1}{8}$ in. long. Style 2 and 3 on the same plant. Fruit $\frac{1}{6}$ in. diam., glabrous or puberulous. Seeds $\frac{1}{8}$ in. ellipsoid, subtrapezoid.

Habitat

Kumaon ; Strachey and Winterbottom. Nepal : Wallich. Sikkim Assam. Khasia common upto 5,000 ft. ; Ceylon Thwaites ; Distrib. Malay and Japan.

2. ***Gymnostemma burmanica*** King. *ex* Chakravarti.

A rather stout climber. Stem pubescent more so on the tender parts. Leaflets 3, nerve 5, lanceolate or ovate lanceolate, densely pubescent with brownish coarse hairs on both surfaces more so on the under surface and aggreted closely on the veins. Middle leaflets 2-2½ in., side ones 1½-2½ in. long, lanceolate or ovate lanceolate. Leaflets never nembranous rather thickish, margin umdulate or crenulate dentate, apex acute or acuminate, leaf-base attenuated; petiole 1-1½ in., generally densely pubescent. Panicles usually 3-6 in. or more. Flowers white; bracteoles $\frac{1}{20}$-$\frac{1}{10}$ in., calyx segments acute $\frac{1}{20}$ in. long. Petals one-nerved, membranous, denticulate, when dry, gives the appearance of a bird's claw, segments $\frac{1}{10}$-$\frac{1}{6}$ in. long. Fruit wanting.

The specimens have been collected from Burma. Dr. King named it *G. barmanica* King's Mss.

Occurrence

Burma . . . . . Maymyo, Upper Burma, July 1888; Coll. J. C. Prazer, Southern Shan States, Taungyi, 1893; Coll. Abdul Khalil, Thamakhan, S. Shan States, Upper Burma; Coll. Abdul Khalil, Maymyo, July 1888; Coll. Badal Khan.

28. Alsomitra

Alsomitra Rœm. Syn. fasc. 2, p. 117, partin 1846 (non *Zanoniae* Sect. *Alsomitra* Bl. Bijdr., p. 937); Benth and Hook. Gen. 1, p. 840; Cogn. in Mart. Fl. Bras. fasc. 78, p. 113; Clarke in Hook. f. Fl. Brit. Ind. 2, p. 634.

Large climbers: tendrils simple or 2-fid. Leaves with 3-oblong entire leaflets. Flowers small dioecious, white, in compound panicles, with filiform branches. *Male:* calyx rotate, 5-partite, segments oblong, acute; corolla rotate 5-partite, segments obtuse, stamens 5, filaments stout, near together at the base; anthers small oblong straight, 1-celled. *Female:* calyx and corolla as in the male; ovary elongate-clavate, 1-celled, sytle 3-4, conical, with semi-lunate stigmas; ovules very many, pendulous; placentas 3, thick, vertical, parietal.

Capsule large, elongate-clavate, truncate, and 3-valved at the apex. Seeds very many, compressed, vertical, in six rows, much corrugated, incised or horned on the margin with a terminal membranous wing, longer than the seed, or 0. Distrib. Species 10, extending from Nepal through Malay to North Australia.

Key to the species

Leaves very fleshy; (fruit narrower) . . . . . 1. *A. sarcophylla.*
Leaves herbaceous; fruit stout—
Fruit glabrous . . . . . 2. *A. clavigera.*
Fruit tomentose . . . . . 3. *A. pubigera.*

1. ***Alsomitra sarcophylla*** Rœm. Syn. fasc., p. 118; Kurz. in Journ. As. Soc. 1878, pt. ii, 106, Hook. f. in Bot. Mag. tab. 6017; Clarke in Hook. f. Fl. Brit. Ind. 2, p. 634; *Zanonia sarcophylla* Wall. Cat. n. 3724; Pl. Asiat. var. 2, p. 28, tab. 133; Walp. Rep. 2, p. 194.

A lofty climber perfectly glabrous everywhere. Stem very slender, copiously branched; branches cylindric, pendulous. Leaves alternate, 3 foliate, petiole very short thick; leaflets 2-3 in. long elliptic-ovate or oblong, or ovate-lanceolate, obtuse or apiculate, quite entire, very fleshy, $\frac{1}{10}$ in., in thickness, bright green and obscurely 3-nerved above, channeled down the middle, paler and reticulated beneath; petiolules about as long as the petiole. Tendrils quite entire. Panicles slender axillary and terminal, pendulous, many-flowered, greenish yellow. Flowers dioecious, shortly pedicelled ebraceteate, $\frac{1}{3}$ in. in diameter, very pale strand-coloured. Sepals ovate-oblong acuminate, half as large as the rotate corolla; corol'a segments elliptic ovate and apiculate. Stamens small recurved, anthers smalladnate. Ovary club-shaped, 1-celled, many ovuled; ovules parietal; styles 3-4 short, conic, stigma semilunar, black. Fruit 2 inches long, subcylindric obtusely 3-gonous smooth, narrow at the base into the pedicel. Seeds compressed; nucellus obovate; testa black, muricate; wing oblong, obtuse hyaline.

A singular climbing evergreen plant, one of a small anomalous tribe of Cucurbitaceæ, which is distinguished by its fine stamens 1-celled anthers and ovary, and very curious fruit, which is almost cylindric, and opens by a tricural slit at the truncate top. It is a stove plant, and has remarkably

fleshy bright green foliage, which is admirably adopted for decorative purposes, keeping fresh for a very long time without water. The flowers which are individually insignificant, are produced in immense abundance. This plant is moreover valuable for being very free from the attacks of scale and other insects-pests of the hot house. It is a native of forests in Burma and Siam, abounding in arid, sterile and exposed situations along with the banks of the Irrawaddy river, where it was discovered by Dr. Wallich in 1826, flowering in the month of November.

Flowers November to February.

Habitat

Burma : from Mandalay to Prome, Wallich, Kurz ; Distributed to Siam.

Occurrence

Burma	Foulin Road, District Minbu, December 1902 Coll. Shaik Mokim ; Myimee, Sagaing District, 4th February 1904 Coll. Ramchandra ; Kyankse, common, Central Burma, 9th January 1904 ; Myaung-u-Minbu District, 19th March 1903 Coll. Aubert and Gage ; Minju, Upper Burma, 1893 Coll. Dr. King's collector ; Fort Stedman, Upper Burma, January 1893 Coll. Abdul Huk ; Collen, Upper Burma, January 1892 Coll. Abdul Huk ; Prome, Pegu, Coll. S. Kurz ; Shan States, Upper Burma, November 18, 1890 Coll. Abdul Huk ; Upper Burma November 1887 Coll. A. Collet ; Kumay Road, 2nd November 1892 Coll. Abdul Huk.
Wall. Cat.	3724, 18th November 1826, Prome Hills, 1826.
Siam	Radhburie, Kedah, September 1890 Coll. C. Curtis.

2. ***Alsomitra clavigera*** Rœm. Syn. fasc. 2, p. 118 ; Clarke in Hook. f. Fl. Brit. Ind. 2, p. 634 ; *Zanonia clavigera* Wall. Cat. n. 3725 : Pl. As. rar. 2, p. 28 ; Walp. Rep. 2, p. 194 ; *Z. integerrima* Wall. Cat. n. 3725.

Stem slender, elongate, branches glabrous, sulcate ; petioles slender, $\frac{1}{2}$-$\frac{2}{3}$ in. long. Leaves herbaceous. Leaflets 3 by $1\frac{1}{2}$ in. acute petiolule often extending $\frac{1}{4}$ in. Fruit 3 by $\frac{3}{4}$ in. at the top, glabrous. Seeds including the wing 1 in. slightly muricated on the flat faces, yellowish-white, much flattened, with several deep triangular spinose teeth at the apex, teeth of 2 lamellæ, between which the wing is inserted, split in the plain of complanation of the fruit, and the wing springing from these narrow splits. Wallich's description of the seed of *Z. clavigera* is incorrect and appears to be taken from *Z. indica*, which grows in the same locality.

Flowers November to February.

Habitat

Sikkim, ascending to 4,000 ft., J. D. H., Gamble, C. B. Clarke. Khasia Mts., alt. 3,000-4,000 ft., H. f. & T. ; Sylhet. Wallich. Tenasserim ; Helfer (Kew Distrib. No. 2520).

Var.? Hookeri : Seeds without any wing. Khasia Mts. alt. 3-4,800 ft.

Occurrence

Assam	Santong, 4,000 ft., 30th May 1895 Coll. Reporter on Economic Products to the Government of India ; Duphla Hills, Akha Hills, January 1890 Coll. Dr. King's collector ; Duphla Hills, January 1890 Coll. Badal Khan ; Gauhati, October 1850 ; Jerria Ghat, 1,000 ft., Khasi Hills, March 1891 Coll. H. Collett ; Kobo, Abor Expedition, 30th November 1911 Coll. I. H. Burkill.
Sikkim	Rungbee, 3,500 ft., Sikkim Himalaya, 18th February 1876 Coll. Dongboo.
Wall. Cat.	H. B. C. 2725 B, Sylhet 3725 A.
Malay Peninsula . . .	Kedah, 500 ft., 26th November 1921.

3. ***Alsomitra Pubigera*** Prain. Journ. As. Soc. Beng. Vol. LXXIII, part 2, p. 292-293.

Scandent shrub, branches beautifully elongate, branchlets puberulous sulcate. Leaves with short petioles pedate 5 leaflets ; leaflets with petiolules ; petiole scarcely straight $\frac{1}{2}$-$\frac{1}{2}$ in. long ; petiolule, terminal $\frac{3}{10}$ in. long, lateral ones $\frac{1}{10}$ in. long. Blade membranous, on both surfaces densely hairy, $1\frac{1}{2}$-4 in. long and $\frac{4}{5}$-$2\frac{1}{2}$ in. in breadth, ovate, acute, subobtuse or retuse margin wholly puberous ; base except the middle one partially oblique, membranous, the upper veins densely hairy

and the blade partially puberulous ; panicles with many healthy flowers. Peduncle sulcate densely puberulous 2-4 in. long ; pedicles puberulous $\frac{2}{5}$ in. long, bracteoles sulcate. The calyx puberulous segments lanceolate, linear acute, corolla glabrous, segments ovate, acute 1 in. long. The fruit subcylindrical with dense puberulous hairs from the top to the bottom, slightly attenuate, apex truncate, base subacute 2·25 in. long and $\frac{1}{2}$ in in diameter, seeds subtriagular margin deeply lobed at the base, oblique attenuate $\frac{3}{10}$ in. long, ·25 in. in breadth and ·15 in. in diameter ; winy white oblique translucent narrow oblong, apex round ·75 in long, ·25 in. in diameter.

Flowers November to January.

This very distinct species is most nearly related to *A. clavigera*, the fruit except for being densely puberulous, being very like those of that species. But it differs very markedly in its pedate leaves and in its spinulose-rugose seeds.

Habitat

Burma . . . . . Kachin Hills, Upper Burma, November 1897 Coll. Shaik Mokim ; Kachin Hills, 300 ft., January 1898 Coll. Shaik Mokim.

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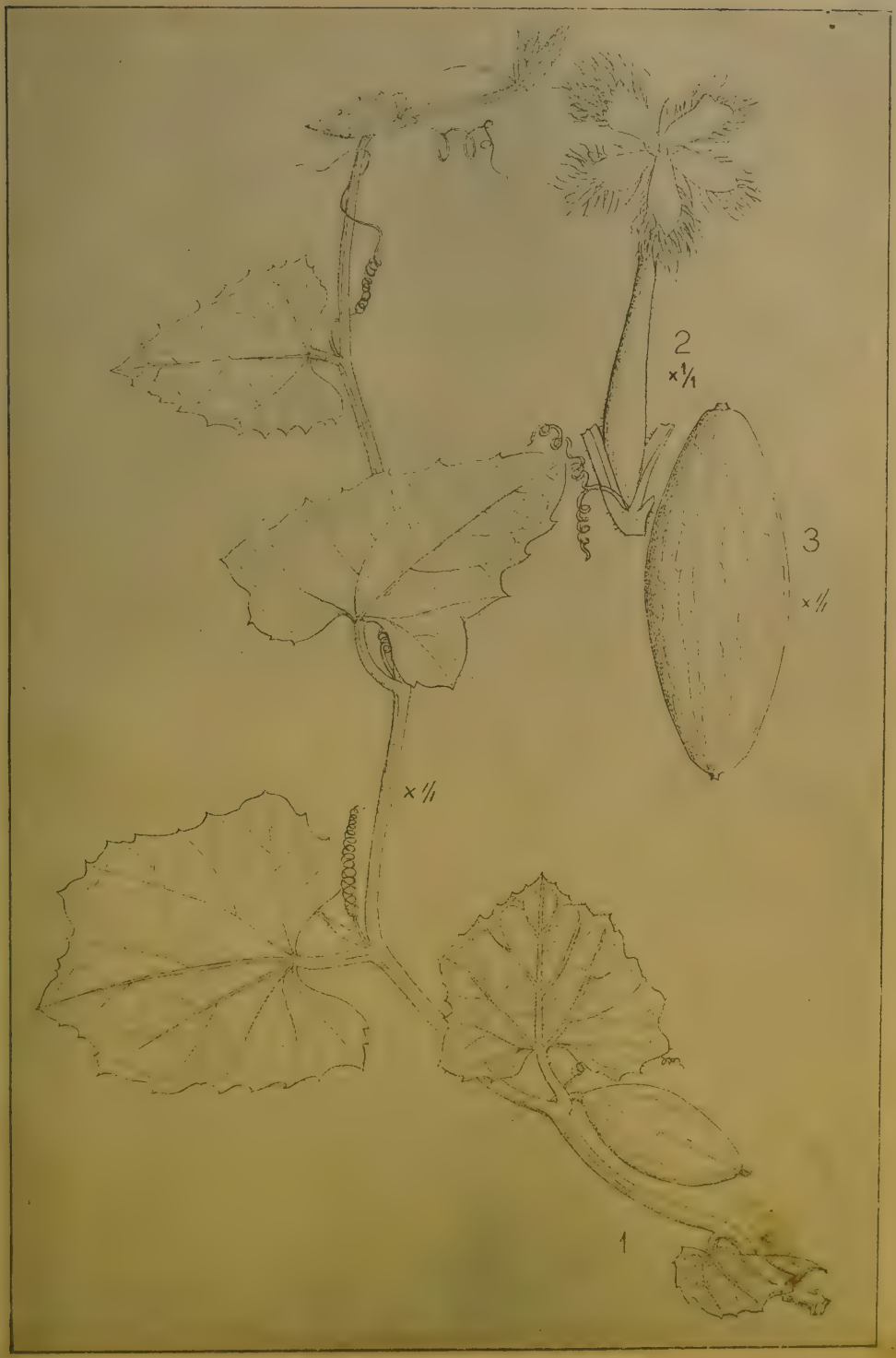
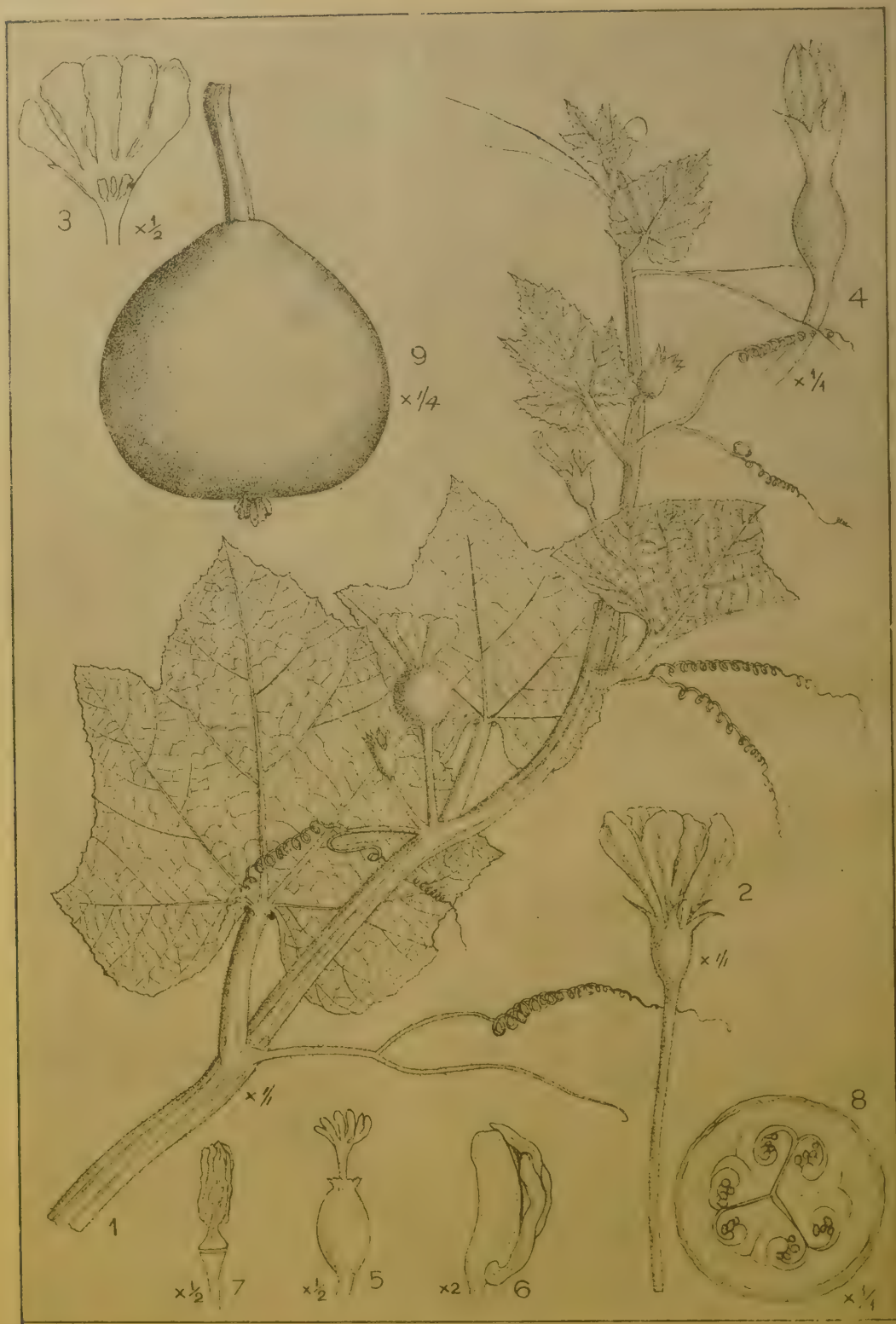


Trichosanthes dioica Roxb.

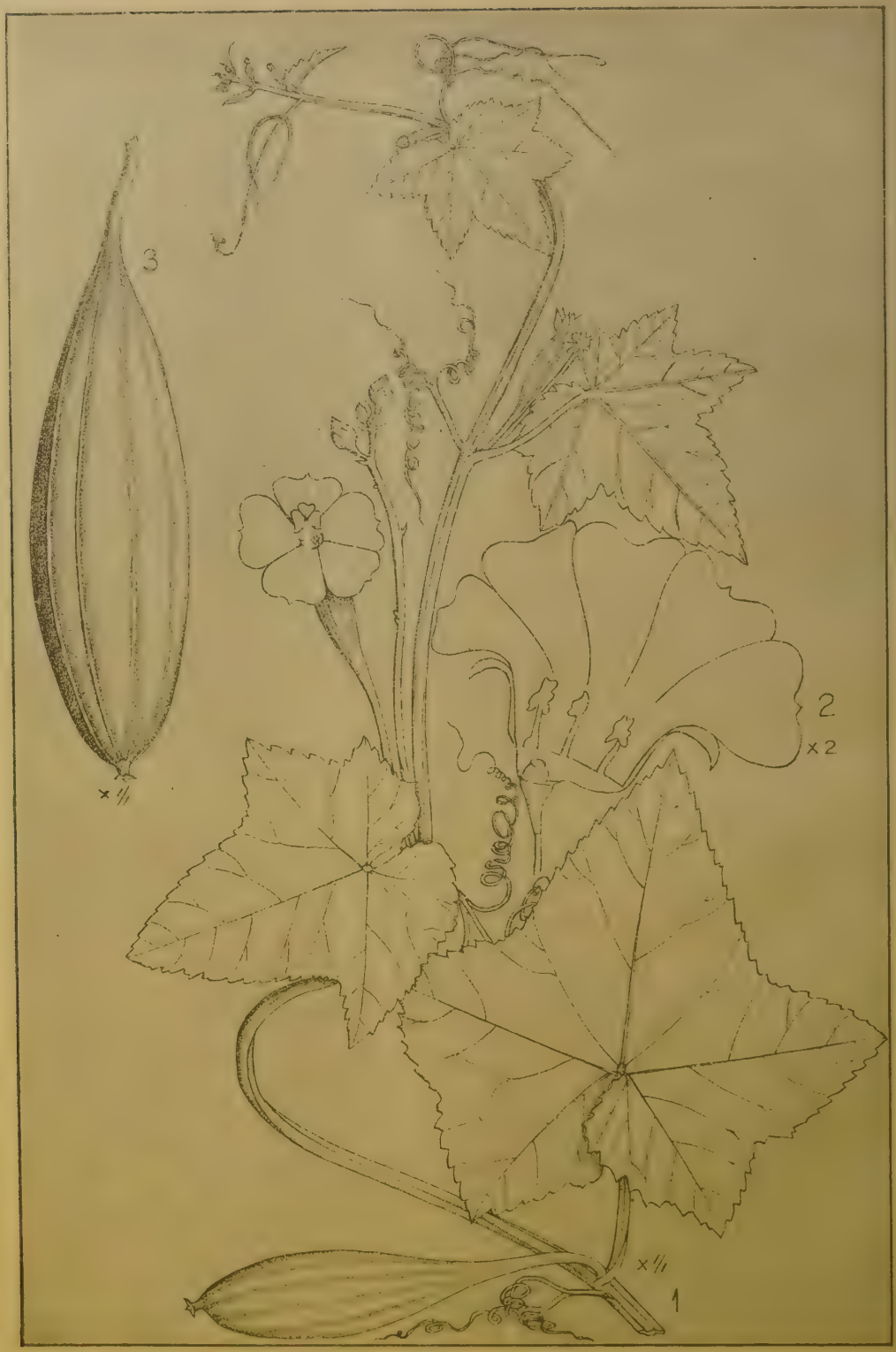


Lagenaria vulgaris Ser.

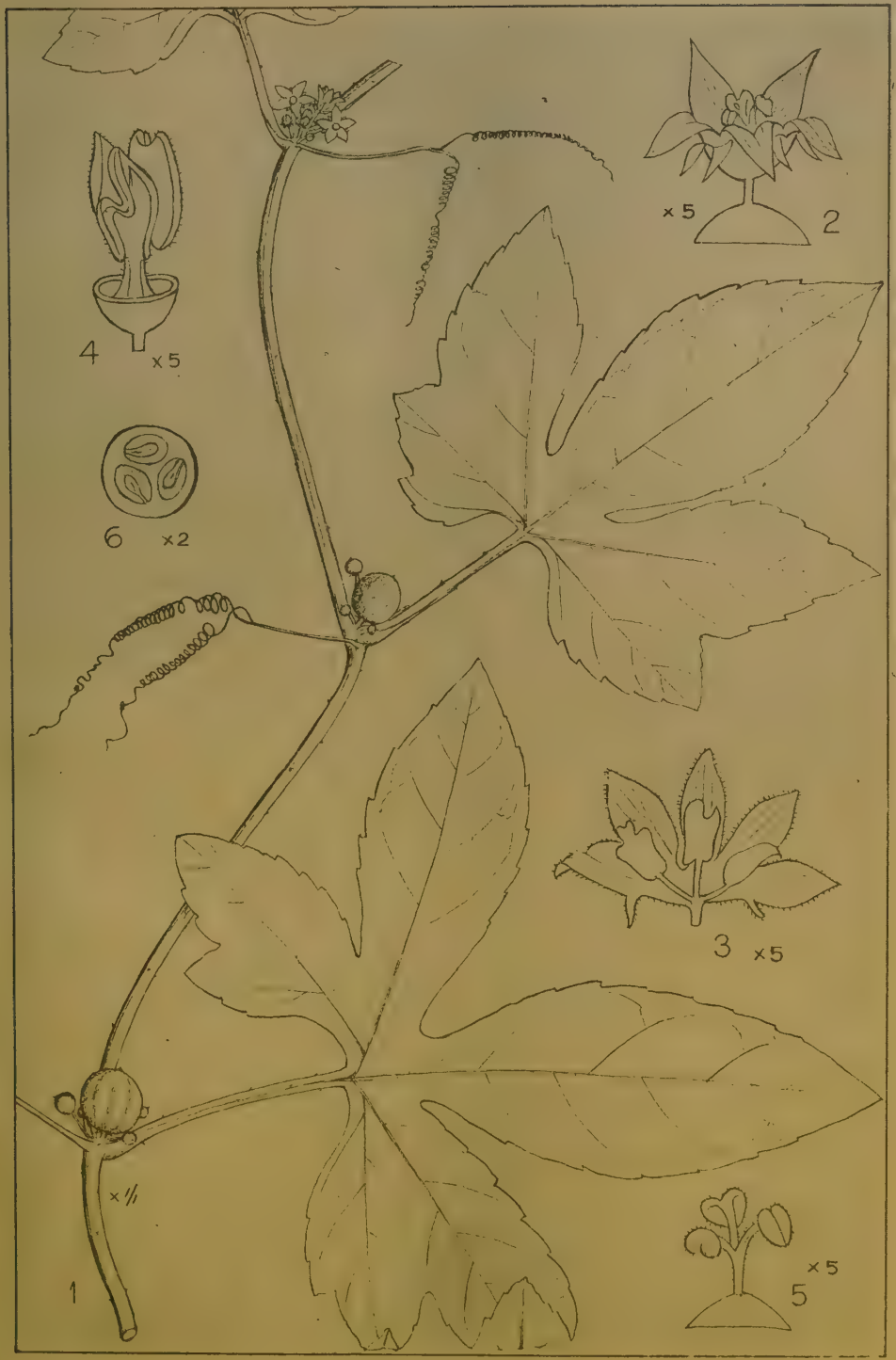
Benincasa hispida Cogn.

Momordica cochinchinensis Spreng.

Momordica charantia Linn.



Luffa acutangula Roxb.

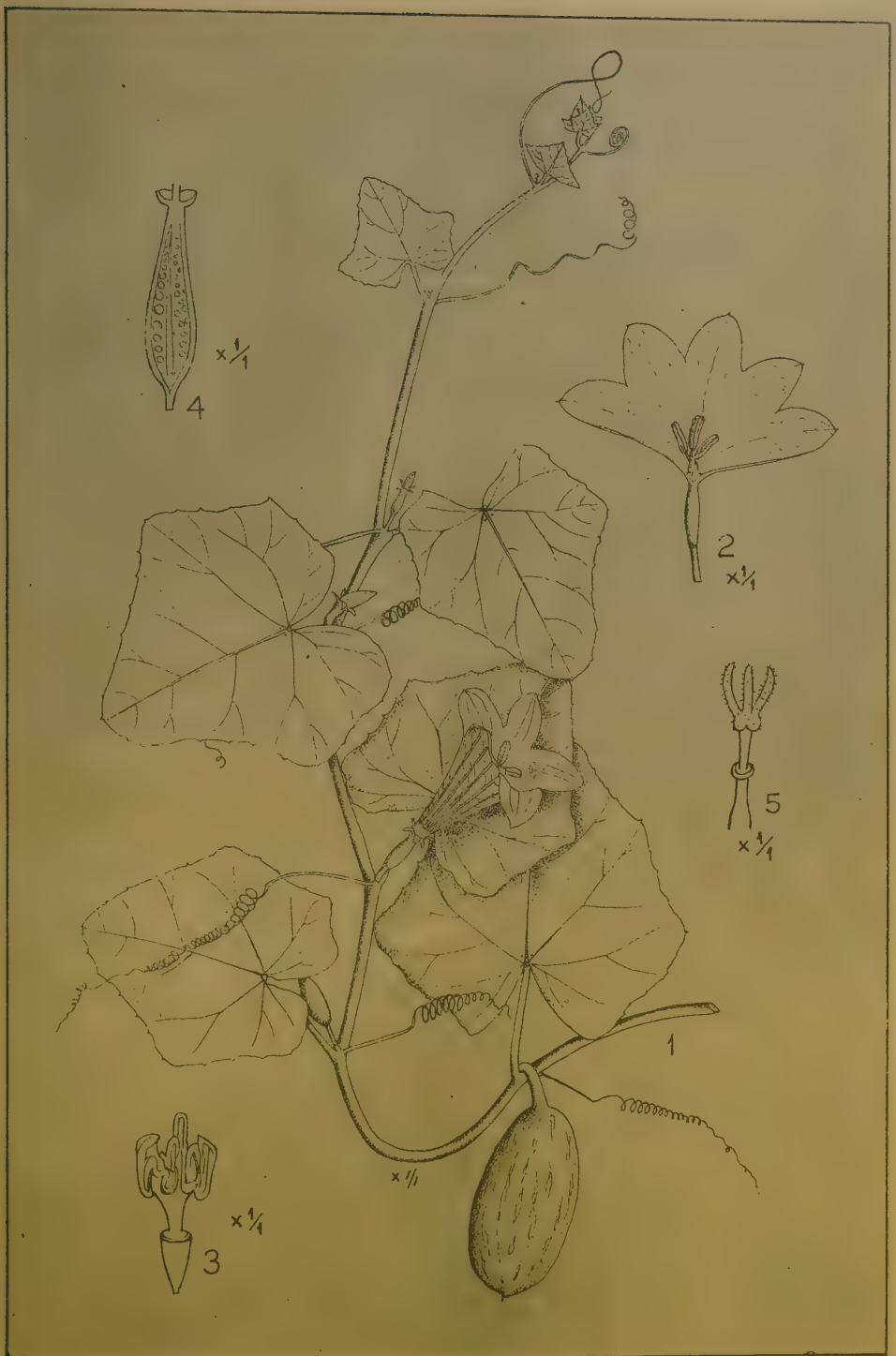


Bryonopsis laciniosa Naud.

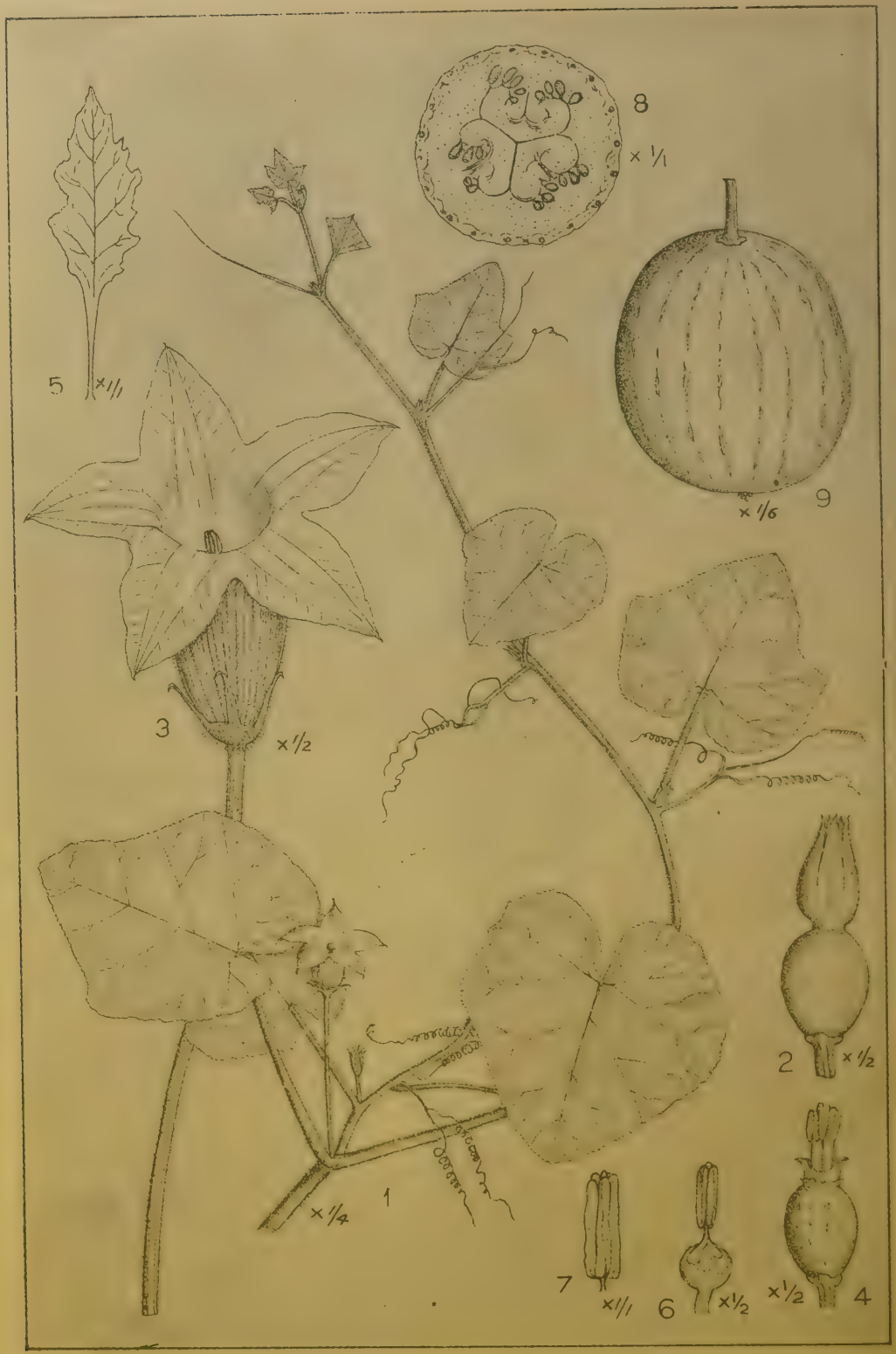
Cucumis melo Linn.

Cucumis sativus Linn.

Citrullus colocynthis Schrad.



Coccinia indica Naud.



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EXPLANATION OF PLATES I—XII

PLATE I. *Trichosanthes dioica* Roxb. fig. 1 a fruiting branch × 1/1 ; fig. 2 a male flower × 1/1 ; fig. 3 a fruit. × 1/1.

PLATE II. *Lagenaria vulgaris* Ser. fig. 1 a flowering branch with female flowers × 1/1 ; fig. 2 a male flower × 1/1 ; fig. 3 dissection of a male flower × ½ ; fig. 4 a female flower × 1/1 ; fig. 5 a female flower calyx and corolla removed, showing ovary with style and stigma × 1/1 ; fig. 6 a stamen separated showing the nature and mode of attachment of the anther with the connective × 2 ; fig. 7 sinuated anthers × ½ ; fig. 8 section of ovary showing placentation × 1/1 ; fig. 9 a fruit × ¼.

PLATE III. *Benincasa hispida* Cogn. fig. 1 a flowering branch × 1/1 ; fig. 2 a fruit × 1/6.

PLATE IV. *Momordica cochinchinensis* Spreng. fig. 1 a flowering branch × 1/1 ; fig. 2 a fruit × ¼.

PLATE V. *Momordica charantia* Linn. fig. 1 a flowering branch × 1/1 ; fig. 2 a fruit × 1/1.

PLATE VI. *Luffa acutangula* Roxb. fig. 1 a flowering branch × 1/1 ; fig. 2 dissection of a male flower × 1/1 · fig. 3 a fruit × 1/1.

PLATE VII. *Bryonopsis laciniosa* Naud. fig. 1 a flowering branch × 1/1 ; fig. 2 dissection of a female flower × 5 ; fig. 3 dissection of a male flower × 5 ; fig. 4 stamens and their attachment ×5 ; fig. 5 style and stigma × 5 ; fig.6 transverse section of ovary × 2.

PLATE VIII. *Cucumis Melo* Linn. fig. 1 a flowering branch × 1/1 ; fig. 2 a female flower × 1/1 ; fig. 3 a male flower × 1/1 ; fig. 4 a fruit × 1/3.

PLATE IX. *Cucumis sativus* Linn. fig. 1 a flowering branch × 1/1 ; fig. 2 dissection of a female flower × 1/1 ; fig. 3 a fruit × ½ ; fig. 4 transverse section of ovary × 1/1.

PLATE X. *Citrullus colocynthis* (Linn). Schrad. fig. 1 a flowering branch × 1/1 ; fig. 2 a female flower × 1/1 ; fig. 3 a fruit × 1/1 ; fig. 4 section of a fruit × 1/1.

PLATE XI. *Coccinia indica* Naud. fig. 1 a flowering branch × 1/1 ; fig. 2 dissection of a female flower with 3 staminodes × 1/1 ; fig. 3 stamens × 1/1 ; fig. 4 longitudinal section of ovary × 1/1 ; fig. 5 style and stigma.

PLATE XII. *Cucurbita maxima* Duchesne fig. 1 a flowering branch × ¼ ; fig. 2 a female flower × ½ ; fig. 3 a male flower × ½ ; fig. 4 a female flower calyx and corolla removed × ½ ; fig. 5 a foliaceous sepal × 1/1 ; fig. 6 stamens and their attachment with a glandular disc × ½ ; fig. 7 stamens × 1/1 ; fig. 8 transverse section of ovary showing placentation and glandular ovarian wall × 1/1 ; fig. 9 a fruit × 1/6.

DECOMPOSITION STUDIES WITH DIFFERENT TYPES OF COMPOSTS IN THE SOIL*

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DURING the course of pot-culture experiments with crops carried out in this laboratory, with a view to comparing the manurial behaviour of composts prepared by different methods, it was noticed that the degree of crop response was influenced not merely by the C/N ratio of the compost applied, but also by the nature of the waste material used in the preparation of the compost. Thus, for the same C/N ratio of the final manure, composts prepared from night-soil and town refuse were found to be more effective, per unit of nitrogen, than composts prepared from resistant farm wastes, e.g. sugarcane trash. As it was inferred that this difference in crop response must have been primarily due to the difference in the rate of liberation of available nitrogen in the two cases, it was considered advisable to carry out systematic experiments in the laboratory in order to compare the rates of

* Work carried out under the Scheme for the "Preparation of Compost Manure from Town Refuse and other Waste Material" financed by the Imperial Council of Agricultural Research

ammonification and nitrification of composts prepared under varying conditions and from different types of waste material.

The experiments were carried out by mixing weighed quantities of the manure with soil and incubating the mixture under optimum conditions of moisture and temperature for definite periods of time, after which the total carbon and nitrogen as well as ammoniacal and nitrate nitrogen present in the sample were determined. Fuller details of the experimental procedure are given below.

Materials and methods

The soil used for the present experiments was a red loam obtained from the Experimental Farm attached to the Indian Institute of Science, Bangalore, which analysed as follows :

Table I

Analysis of soil used

Mechanical composition		Chemical composition	
	Per cent		Per cent
Coarse sand	33·4	Total carbon	0·59
Fine sand	26·4	„ nitrogen	0·058
Silt	7·7	„ P_2O_5	0·02
Clay	26·4	„ K_2O	0·22
Moisture	3·84	„ Lime (CaO)	0·10
Loss on ignition	3·19	Silica (SiO_2)	77·76
Carbonate	*nil*	Iron and alumina ($Fe_2O_3+Al_2O_3$)	13·75
*p*H	6·2		

It would be noted that the soil contains average amounts of carbon and nitrogen for Indian red loams, but is poor in phosphoric acid.

For the decomposition studies, weighed amounts of well-powdered, dry composts were added to 100 gm. portions of the soil in 250 c.c. wide-necked bottles, mixed thoroughly and incubated at 28°-30°C., after adjusting the moisture content to about 50 per cent of the water holding capacity, by the addition of distilled water. About 18 c.c. of water were required in the present case for each 100 gm. portion of soil. The loss of moisture during incubation was made up by fresh additions of distilled water every alternate day, and the mass was well stirred after each such addition, in order to ensure better distribution of moisture and aeration. Care was taken to add just enough water to bring the soil to a good tilth and to avoid clogging and anaerobic conditions due to excess of moisture. It was found that a visual check to ensure the above condition was more effective than weighing the bottles each time.

At the end of definite periods (2, 4, 8, 12 and 20 weeks) duplicate bottles were removed from the incubator and the whole of the contents were carefully scraped out and transferred into wide porcelain dishes to dry. The last traces of adhering soil and salts were washed out from the sides of the bottle with a small quantity of distilled water. The soil mass in the porcelain dish was dried in an incubator kept at 45–50°C. and when dry was taken out and kept in the laboratory for a day in order that

equillibrium with the air might be achieved. The air-dry weight of the mass was determined, after which it was powdered and aliquots were taken for the determination of moisture, organic carbon, total nitrogen ammoniacal nitrogen and nitrate nitrogen. Organic carbon was determined by the chromic oxidation method of Acharya [1936], total nitrogen by the Gunning modification of Kjeldahl's method [A.O.A.C., 1935], ammoniacal nitrogen and nitrate nitrogen by Olsen's method [1929]. Changes in organic matter are expressed in terms of carbon and all values have been calculated in terms of the total quantities present in the experimental samples taken.

Decomposition of soil organic matter

Since in the present studies the decomposition of the organic matter present in the soil is likely to be superimposed on the decomposition of added compost material, a set of preliminary experiments was carried out in order to follow the course of decomposition of the organic matter originally present in the soil and to test the influence of factors such as addition of lime or phosphate or diluting the soil with sand. Four sets of bottles were run one set with soil alone without the addition of any chemicals ; the second set with soil mixed with 100 gm. of washed quartz sand ; the third set with soil mixed with 5 gm. of calcium carbonate ; and the fourth set with soil mixed with 100 gm. of sand and 0·5 gm. of potassium phosphate (K_2HPO_4). The other details relating to incubation and analysis were the same as given in the last paragraph and the results obtained are presented in Table II.

Table II

Carbon and nitrogen changes in incubated soil

Materials added	Incubation period	Total organic carbon in mg.	Total nitrogen in mg.	Ammoniacal nitrogen in mg.	Nitrate nitrogen in mg.	Total available nitrogen in mg.
I. 100 gm. soil without any addition of chemicals	Initial	590	58·0	*nil*	0·80	0·80
	2 weeks	606	61·2	0·52	1·20	1·72
	4 ,,	632	63·0	0·80	1·60	2·40
	8 ,,	624	64·2	1·20	2·40	3·60
	12 ,,	616	62·4	1·00	3·20	4·20
	20 ,,	598	60·2	0·80	2·60	3·40
II. 100 gm. soil +5 gm. calcium carbonate	Initial	590	58·0	*nil*	0·80	0·80
	2 weeks	608	62·2	0·32	1·20	1·52
	4 ,,	644	66·6	0·60	2·60	3·20
	8 ,,	626	61·4	0·80	3·80	4·60
	12 ,,	606	59·6	0·60	3·60	4·20
	20 ,,	586	57·2	0·30	1·80	2·10
III. 100 gm. soil +100 gm. sand	Initial	590	58·0	*nil*	0·80	0·80
	2 weeks	618	62·4	0·80	1·40	2·20
	4 ,,	636	64·8	1·40	2·80	4·20
	8 ,,	644	63·1	1·20	3·40	4·60
	12 ,,	612	60·8	1·00	3·80	4·80
	20 ,,	602	59·2	0·60	2·10	2·70
IV. 100 gm. soil +100 gm. sand +0·5 gm. K_2HPO_4	Initial	590	58·0	*nil*	0·80	0·80
	2 weeks	624	63·6	1·40	1·40	2·80
	4 ,,	652	68·4	1·80	2·80	4·60
	8 ,,	638	65·6	2·00	3·60	5·60
	12 ,,	622	63·4	1·60	4·20	5·80
	20 ,,	596	56·6	1·00	2·80	3·80

Carbon and nitrogen

On incubating the moist soil at 28°-30°C. there occurs in the first four weeks appreciable fixation of carbon and nitrogen from the atmosphere. The fixation is somewhat helped by the addition of lime or sand to the soil and is markedly improved by the addition of potassium phosphate. Under optimum conditions, the fixation of carbon amounts to about 10 per cent on the initial value and of nitrogen to about 18 per cent. The maximum values are generally reached at the end of four weeks. Similar data have been reported by Basu and Vanikar [1942].

The simultaneous fixation of carbon and nitrogen is explicable as being due to the rapid development of a nitrogen fixing algal flora in the soil [De, 1939 ; Allison and Hoover, 1935]. This algal flora is, in the second stage, probably attacked by bacteria, leading to the loss of both carbon and nitrogen.

The complication which this process of natural nitrogen and carbon fixation taking place in soils creates in interpreting data obtained on the decomposition of organic manures added to the soil, does not appear to have been emphasized by workers in the field. The degree of ambiguity caused in the present case is set out in Table III, wherefrom it would be seen that the quantities of carbon and nitrogen added to soil by natural fixation amount to about 40-60 per cent of the quantities normally added in the form of compost manure (at the rate of 10 tons of dry manure per acre which is equivalent to about 1 gm. of manure per 100 gm. of top soil).

TABLE III

Nitrogen and carbon in soil with and without manure

	Carbon in mg.	Nitrogen in mg.
I. Originally present in 100 gm. soil	590	58
II. Added in 1 gm. of dry compost per 100 gm. of soil representing 10 tons of dry manure per acre	120	10
III. Carbon and nitrogen fixed by 100 gm. of soil without manure in four to eight weeks (Table II)	40-60	6-8
IV. Available nitrogen (i.e. ammoniacal nitrogen +nitrate nitrogen) produced in the above soil in 8-12 weeks under optimum conditions (Table II)	..	4-6

While studying the carbon and nitrogen changes undergone by compost or other organic manure mixed with soil, one therefore meets with two different systems working simultaneously—one being the fixation processes taking place in the soil and the other being the decomposition processes occurring in the added manure. Since these react in opposite directions, the overall balance of total carbon and total nitrogen present in the system at any particular stage, would give no measure of the extent of decomposition undergone by the added manure. It is difficult to obtain values for the decomposition of the manure alone by deducting from the observed values the 'control' values for the incubated soil, since there is considerable interaction between the manure added and the fixation taking place in the soil ; in other words, the carbon and nitrogen fixing capacity of the soil is markedly influenced by addition of organic manure.

Though the total carbon and nitrogen values of the soil-cum-organic manure system do not possess, from the scientific standpoint, any definite interpretative value, they possess considerable bearing on the 'practical' side, as indicating the 'overall' result that may be expected to occur in the field, when organic manures such as composts are applied to the land. From this point of view, it was considered worthwhile to include the total carbon and total nitrogen determinations in the experiments reported in this paper.

It would be noted from Table II that after the fourth week, both carbon and nitrogen values of the incubated soil show a progressive decrease and at the end of 20 weeks they recede back to the initial values.

The changes in ammoniacal and nitrate nitrogen of the incubated soil are of the usual recognized type. There is an accumulation of nitrate in the system for a period of 8 to 12 weeks, after which there is loss of nitrate, probably in the gaseous form. The total 'available' nitrogen, including in this term both ammoniacal and nitrate nitrogen, reaches a maximum at the end of 12 weeks, after which it shows a rapid fall. The quantity of 'available nitrogen' formed is slightly increased by the addition of lime or sand to the soil, and is markedly increased by the addition of potassium phosphate.

Preliminary trials with nitrogenous materials

Before undertaking studies relative to the decomposition of composts, it was considered advisable to test for the presence of an active microflora in the soil capable of bringing about rapid decomposition of added organic materials and nitrification of the ammonia produced. For this purpose, preliminary trials were carried out by adding to the soil various nitrogenous organic materials such as activated sludge, dried blood, egg albumin, hongay-cake, night soil and cattle dung, and carrying out incubation for 4 to 12 weeks. It is unnecessary to present the data so obtained, but they showed the presence of an active microflora in the soil, which brought about carbon decomposition, ammonification and nitrification.

Decomposition of composts

A large number of samples of composts prepared by different methods in connection with the work reported elsewhere [Acharya, 1939 and 1940] were used in the present decomposition studies, but in order to avoid repetition of data obtained for similar types of composts, only such data are presented as have a direct bearing on the three important factors referred to at the head of this paper as possibly influencing the rate of nitrification of composts, viz. (*a*) nature of waste material used, (*b*) C/N ratio of the compost, and (*c*) method of preparation.

In order to obtain a wide range of necessary samples, three methods of composting were tried, viz. (*a*) aerobic method, with turnings every fortnight for three months; (*b*) hot fermentation method in trenches [Acharya, 1939 and 1940]; and (*c*) plastering the compost mass in trenches with mud paste from the beginning, without any subsequent turning, which for convenience of denomination could be styled 'anaerobic'. Method (*a*) gave products of the narrowest C/N ratios and (*c*) the widest. By applying these three methods to different types of refuse, e.g. (i) night-soil and town refuse, (ii) farm refuse containing cattle dung and urine, and (iii) farm refuse poor in nitrogen, e.g. sugarcane trash, it was possible to obtain a series of composts, prepared from different types of waste material, possessing C/N ratios varying from 10 : 1 to 30 : 1. Fuller particulars of the composts so prepared are given in Table IV.

Table IV

Nature of composts used in the decomposition studies

List No.	Nature of original refuse	Method of composting	Analysis on dry basis		C/N ratio
			Carbon per cent	Nitrogen per cent	
A	Compost from town refuse and night soil	Aerobic, in heaps overground	11·45	1·08	10·6
B	Do.	Hot fermentation in trenches	15·62	1·26	12·4
C	Do.	Anaerobic, in trenches	18·81	1·14	16·5
D	Compost from mixed farm refuse (leaves, weeds, dung, urine, etc.)	Aerobic, in heaps overground	9·27	0·82	11·3
E	Do.	Hot fermentation in trenches	13·63	0·96	14·2
	Do.	Anaerobic, in trenches	17·17	0·81	21·2
G	Compost from sugarcane trash	Aerobic, in heaps overground	9·83	0·64	13·8
H	Do.	Hot fermentation in trenches	11·80	0·69	17·1
I	Do.	Anaerobic, in trenches	17·70	0·53	33·4

Enough of the manure was added in each case to supply 20 mg. of nitrogen per 100 gm. of soil. The results obtained are set out in Table V.

TABLE V

Carbon and nitrogen changes during the decomposition of composts in the soil

Manure No.	Nature of compost	C/N ratio	Period of incubation	Total carbon in mg.	Total nitrogen in mg.	Ammoniacal nitrogen in mg.	Nitrate nitrogen in mg.	Total available nitrogen in mg.
A	Town refuse + night soil, compost, aerobic	10·6	Initial	802	78·0	*nil*	0·80	0·80
			2 weeks	761	75·2	2·24	1·20	3·24
			4 ,,	744	73·1	2·02	4·46	6·48
			8 ,,	752	76·0	1·40	9·14	10·54
			12 ,,	786	78·4	1·20	7·20	8·40
			20 ,,	772	76·2	0·80	5·26	6·06
B	Town refuse + night soil, hot fermentation	12·4	Initial	838	78·0	*nil*	0·80	0·80
			2 weeks	799	76·2	1·80	1·04	2·84
			4 ,,	766	74·8	2·42	2·76	5·18
			8 ,,	764	77·6	2·02	7·64	9·66
			12 ,,	786	80·2	1·44	8·74	10·18
			20 ,,	798	82·6	1·02	7·58	8·60
C	Town refuse + night soil, anaerobic	16·5	Initial	920	78·0	*nil*	0·80	0·80
			2 weeks	896	77·3	1·24	*nil*	1·24
			4 ,,	862	76·7	2·04	2·22	4·26
			8 ,,	841	78·4	1·84	5·78	7·62
			12 ,,	822	81·6	1·26	7·56	8·82
			20 ,,	808	83·4	0·96	7·22	8·18
D	Mixed farm refuse, compost, aerobic	11·3	Initial	816	78·0	*nil*	0·80	0·80
			2 weeks	791	76·6	1·86	1·24	3·10
			4 ,,	774	74·2	2·04	3·62	5·68
			8 ,,	766	78·4	1·80	6·96	8·76
			12 ,,	782	79·2	1·42	7·22	8·64
			20 ,,	794	80·5	0·94	6·46	7·60
E	Mixed farm refuse, hot fermentation	14·2	Initial	874	78·0	*nil*	0·80	0·80
			2 weeks	841	77·2	1·46	*nil*	1·46
			4 ,,	819	75·4	1·84	2·56	4·40
			8 ,,	801	79·2	1·46	5·86	7·32
			12 ,,	796	81·8	1·64	6·24	7·88
			20 ,,	811	83·6	1·22	5·02	6·24
F	Mixed farm refuse, anaerobic	21·2	Initial	1014	78·0	*nil*	0·80	0·80
			2 weeks	972	78·6	*nil*	*nil*	*nil*
			4 ,,	933	80·1	0·82	0·26	1·08
			8 ,,	899	81·3	1·24	1·92	3·16
			12 ,,	868	82·6	1·46	3·22	4·68
			20 ,,	831	84·2	1·02	4·68	5·70
G	Sugarcane trash compost, aerobic	13·8	Initial	866	78·0	*nil*	0·80	0·80
			2 weeks	834	76·2	1·24	*nil*	1·24
			4 ,,	809	75·6	1·68	1·34	3·02
			8 ,,	798	77·4	1·84	3·66	5·50
			12 ,,	789	78·6	1·64	4·88	6·52
			20 ,,	798	80·8	1·24	5·24	6·48

TABLE V—*contd.*

Carbon and nitrogen changes during the decomposition of composts in the soil—contd.

Manure No.	Nature of compost	C/N ratio	Period of incubation	Total carbon in mg.	Total nitrogen in mg.	Ammoniacal nitrogen in mg.	Nitrate nitrogen in mg.	Total available nitrogen in mg.
H	Sugarcane trash compost, hot fermentation	17·1	Initial	932	78·0	*nil*	0·80	0·80
			2 weeks	901	77·2	*nil*	*nil*	*nil*
			4 ,,	873	78·2	1·24	0·68	1·92
			8 ,,	848	79·6	1·64	1·88	3·52
			12 ,,	829	81·4	1·82	3·42	5·24
			20 ,,	819	83·0	1·24	3·84	5·08
I	Sugarcane trash compost, anaerobic	33·4	Initial	1258	78·0	*nil*	0·80	0·80
			2 weeks	1162	78·2	*nil*	*nil*	*nil*
			4 ,,	1074	78·8	*nil*	*nil*	*nil*
			8 ,,	998	80·2	0·86	*nil*	0·86
			12 ,,	938	82·4	1·64	0·80	2·44
			20 ,,	882	84·6	1·84	1·48	3·32

Changes in total carbon

The figures presented in Table V show that though the initial quantities of carbon present in the soil-cum-compost systems A to I varied greatly from 800 to 1260 mg., there was a tendency for the carbon figures to come down rapidly to a stable level round about 780-800 mg., this level of 780-800 mg. carbon corresponds to a C/N ratio of about 10 : 1 and is in agreement with the known comparative stability of soil humus which exhibits a similar C/N ratio.

Changes in total nitrogen

There is a decrease in total nitrogen in the first few weeks of decomposition, especially in cases where the initial C/N ratio of the manure is narrower than 15 : 1, after which there is a period of progressive increase in total nitrogen, due presumably to fixation from the air. The fixation is inappreciable in cases where the C/N ratio of the compost is near 10 : 1, but it increases markedly as the ratio gets wider. Thus, in the case of composts F and I (Table V), whose C/N ratios are wider than 20 : 1, the final nitrogen content of the soil-cum-compost system at the end of 20 weeks is about 8 per cent higher than at the start.

A comparison of the data presented in Table V against that presented in Table II would show that the addition of compost of C/N ratio narrower than 15 : 1 delays the start of the natural nitrogen fixation processes occurring in the soil by about 4 to 8 weeks. After the above interval, fixation of both carbon and nitrogen from the air start taking place progressively. In cases where composts with C/N ratios wider than 15 : 1 are added, the above lag period in nitrogen fixation is considerably lessened, but even in such cases, the overall fixation of nitrogen (2 to 4 mg.) is less than in the case of soil alone (6 to 8 mg. Table II). The lower fixation in presence of added compost may be due to the fact that the nitrogen level of the soil rises from 60 mg. nitrogen per 100 gm. soil to 80 mg. nitrogen on the addition of compost : and at the higher level, the tendency for further nitrogen fixation may be lessened. It is also possible that loss of nitrogen may take place from the decomposing compost and thus decrease the overall nitrogen fixation figures.

Changes in available nitrogen

The data presented in Table V show that the rate of liberation of 'available nitrogen' (ammoniacal plus nitrate nitrogen) and the total quantity liberated, vary inversely with the C/N ratio of the added material—the narrower the C/N ratio, the greater are the rate and quantity of available nitrogen produced.

Comparing the present data with the figures given in Table II for soil alone, it would be seen that except in the case of composts F and I, which possess C/N ratios wider than 20 : 1, in other cases the application of composts has proved beneficial in increasing the quantity of available nitrogen produced in the soil. Compost H with a C/N ratio of 17 : 1 is on the marginal line, the quantity of available nitrogen produced being almost the same as in the untreated soil. Compost F with a C/N ratio of 21.2 shows an initial period of depression of available nitrogen extending over the first eight weeks, after which the system becomes 'normal' and equal to the untreated soil. In the case of compost I (C/N ratio, 33.4), the period of depression extends over more than 20 weeks.

It is evident from the above that composts F, H and I with C/N ratios wider than 15 : 1, would not react beneficially on crop growth, but on the other hand, may react harmfully by depressing the formation of available nitrogen in the soil, unless a long period of decomposition, extending over four to six months, is allowed to elapse before the succeeding crop is put in.

Influence of method of preparation on the rate of decomposition

A perusal of the data presented in Table V would indicate that the method of preparation of compost exerts its influence on the rate of decomposition of the manure in the soil, mainly by way of controlling the C/N ratio of the compost prepared. Thus the aerobic method, involving several turnings given to the material, gives a product of the narrowest C/N ratio, while the hot fermentation method gives products of somewhat wider C/N ratios and the 'anaerobic' method, as described in this paper, gives products of the widest C/N ratios. The nature of the waste material determines also to a certain extent the C/N ratio of the compost prepared. Thus, compost G, prepared aerobically from a resistant type of waste material such as sugarcane trash, possessed a wider C/N ratio (13 : 8) than compost B (12 : 4) prepared from town refuse and night-soil by the hot fermentation process.

Comparing composts A, B, D, E and G, all of which possess C/N ratios lying within the range 10 : 1 to 14 : 1, it would be noticed that the total quantity of available nitrogen produced in a period of 8 to 12 weeks is maximum in the case of composts A and B prepared from night-soil and town refuse. Composts D and E prepared from mixed farm wastes including leaves, weeds, dung and urine, give somewhat lower values, whereas compost G, prepared from sugarcane trash, shows the lowest value. It is noteworthy that though compost G has a C/N ratio (13.8) narrower than that of E (14.2), still it shows a poorer performance than the latter.

The present data offer an explanation for the better crop response obtained by the writers from night-soil-town refuse composts in pot culture experiments, as compared to other types of composts, even though the C/N ratios were more or less similar in all cases.

Discussion

The results presented above would indicate that the two important factors which control the rate of release of nitrogen in an available form from compost manure are : (i) the C/N ratio of the manure and (ii) the nature of the original waste material or starter used for compost-making. The actual method of preparation of compost exerts only an indirect influence by controlling the C/N ratio of the final product obtained.

Of the above two factors, the first one relating to the influence of C/N ratio of a material on the rate of liberation of ammoniacal nitrogen has been already examined in detail by workers in the field. Richards *et al.* [Hutchinson and Richards 1921; Rege, 1937; Richards and Norman, 1931] found that when the nitrogen content exceeded about 1·6 per cent on the dry basis, the material contained in general more nitrogen than what was actually needed for its microbial decomposition and the excess was set free in the form of ammonia. Expressing the above results in terms of C/N ratio, it may be stated, that when the C/N ratio was narrower than 25 : 1, the material usually liberated a portion of its nitrogen in the form of ammonia, when subjected to microbial decomposition.

The above relationships apply mainly to plant materials which are unfermented to start with. The present experiments with composts go to show that composts possessing C/N ratios narrower than 15 : 1 tend to liberate 'available nitrogen' and thus to increase soil fertility, while composts

possessing wider C N ratios tend to absorb 'available nitrogen' from the soil, and thus to decrease soil fertility though temporarily. To ensure a satisfactory rate of release of 'available nitrogen' from the very early stages of decomposition, it would be preferable to have the C N ratio of the compost narrower than 12 : 1.

As regards the second factor, viz. the influence of the nature of the original waste material or starter used for compost making on the rate of liberation of 'available nitrogen' from the compost, its importance does not appear to have been stressed by previous workers in the field. The general view at present is that when plant materials of diverse composition undergo microbial decomposition, they yield ultimately a more or less similar type of humified material—a ligno-protein complex, with a C/N ratio near 10 : 1 and possessing definite properties [Waksman, 1938]. But it is well known that the final product obtained is not homogeneous, but is a complex mixture consisting in the main of two groups of substances, viz. (*a*) unattacked residues of the original plant materials, and (*b*) synthetic and degradation products of microbial metabolism.

The quantitative distribution of the nitrogen originally present in the refuse or starter, between the above two groups (*a*) and (*b*) in the ultimate compost has not received much scientific attention. It is suggested by the authors that the variation in the rate of release of available nitrogen from composts possessing similar C N ratios, noted in the present paper, may be accounted for by the differential distribution of nitrogen between the above groups (*a*) and (*b*). Thus, in the case of a compost prepared from sugarcane trash and dung, it is possible that a large part of the nitrogen present in the compost may belong to the group (*a*), representing resistant proteins of the original trash not broken down by the micro-organisms, whereas in the case of composts prepared from night-soil or from cattle wastes or from succulant material such as leaves and grass, a good portion of the final nitrogen of the compost may be microbial nitrogen belonging to the group (*b*). It has been found [Waksman, 1931] that microbial nitrogen is readily ammonified and nitrified.

Further work is being carried out by the authors in order to devise methods for estimating quantitatively the two groups (*a*) and (*b*) present in different types of compost material and comparing the rates of liberation of available nitrogen from them.

Summary

1. The course of decomposition of composts, prepared under varying conditions, when added to soil has been followed, with special reference to changes in carbon and in ammoniacal, nitrate and total nitrogen.

2. The influence of the following factors on the course of decomposition has been examined :

(*a*) method of composting—aerobic, hot fermentation and anaerobic ;

(*b*) C/N ratio of the compost, and

(*c*) nature of the original waste material or starter used in preparing the compost.

3. A red loam garden soil, used in the present experiments, when incubated without the addition of compost, was found to fix about 6 to 8 mg. nitrogen from the air per 100 gm. soil, corresponding to about 10 15 per cent of the initial nitrogen content of the soil. With regard to carbon, there was an initial period of fixation from the air, followed by progressive loss in the later stages.

4. In the soil-cum-compost system there generally occurred an initial period of nitrogen loss, followed by a longer period of nitrogen fixation from the air. The extent and duration of the initial loss of nitrogen was found to be greater, the narrower was the C N ratio of the added compost. When the C N ratio was wider than 15 : 1 the loss of nitrogen was negligible ; on the other hand, appreciable fixation of nitrogen from the air occurred. The total quantity of nitrogen fixed by 100 gm. of soil was, however, less in the presence of added compost than in its absence.

5. When composts of varying C N ratios were added to the soil, the rate of loss of carbon was greater in the case of materials of wider C N ratios, and in about 20 weeks, a more or less similar carbon level corresponding to a C N ratio of about 10, was rapidly reached in all cases.

6. The rate of liberation of 'available nitrogen' (ammoniacal plus nitrate nitrogen) in the soil-cum-compost system, depended mainly on two factors, viz. (*a*) the C N ratio of the compost added —the narrower the C N ratio, the quicker and greater was the liberation of available nitrogen ; and

(*b*) the nature of the original waste material or starter used in the preparation of the compost. Thus, composts prepared from night soil and town-refuse or from cattle wastes were found to liberate a greater proportion of available nitrogen than composts prepared from resistant types of farm wastes, such as sugarcane trash, though the C/N ratios of the composts were about the same in all the cases.

7. The method of preparation of compost—aerobic, hot fermentation or anaerobic—influences the rate of liberation of 'available nitrogen' only indirectly by controlling the C/N ratio of the manure obtained by the method in question.

8. It is concluded that for securing a rapid liberation of available nitrogen and thus obtaining increased crop yields, composts should preferably be prepared from mixed wastes, part of which should be rich in nitrogen, e.g. night-soil, urine, cattle-dung, slaughterhouse wastes, etc., otherwise special organic or inorganic nitrogenous starters should be added while preparing the compost. The final C/N ratio of the compost should preferably be narrower than 12 : 1.

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OBSERVATIONS ON JUTE AND CELLULOSE-DECOMPOSING MICRO-ORGANISMS

I. THE EFFECT OF THE NUTRIENT MEDIUM ON THE SPORULATION OF *CHAETOMIUM CHARTARUM* BERKELEY AND *CHAETOMIUM GLOBOSUM* KUNZE

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DURING the storage of a culture of *Chaetomium chartarum* Berkeley which had been isolated from an active perithecial growth on raw jute fibres it was observed that growth and sporulation were markedly affected by the nature of the medium on which successive subcultures were made. Because of the possibility that synthetic media might not be suitable for full characteristic development of this

strong jute-fermenter, the species was transferred from Czapek-Dox medium to potato slant. Sub-cultures were subsequently continued on this medium and when next examined after some 6 or 7 subcultures on the potato medium it was suspected that the culture had lost, or nearly lost, its ability to produce sexual spores, even when grown on cellulose, although conidia seemed to be produced in profusion. This particular species is an important one in relation to jute which seems to be its natural habitat and on which it grows very easily with damage to the fibre. It was decided, therefore, to study systematically its reproductive properties in relation to the nutrient medium with a view to selection of a suitable medium for storage in characteristic conditions. Along with this degenerate strain (Lab. No. 58), two freshly isolated species were included in the experiments. These were *Chaetomium chartarum* Berkeley (Lab. No. 75) isolated from the same source and subcultured only twice on cellulosic media before test and the important cotton-destroying species, *Chaetomium globosum* Kunze (Lab. No. 79) isolated from an active perithecial growth on brown paper in contact with moist soil, subcultured only once, on cellulosic medium before test.

Description of species

Short morphological descriptions, obtained from examination of the mature first cultures on cellulose agar, of the two freshly isolated species are given below.

Ch. chartarum (*Lab. No. 75*). Perithecia black to naked eye, deep brown under the microscope, with hairs, brown, septate, roughened, incrusted, reticulately branched. Ascospores smooth, ends pointed, boat-shaped but quickly distending to roundness at the middle when mounted in lactophenol, measuring 5-5·5μ×4-4·5μ when flat. Conidiophores short, pointed, swollen in the middle, usually single, bearing a long chain of conidia at the tip. Conidia round, spinulose, dark brown when mature, 3·25μ in diameter.

Ch. globosum (*Lab. No. 79*). Secretes a yellow to brown pigment. Perithecia dark olive green and visibly bigger than those of No. 75, brown, with a scaly surface under the microscope, with hairs, highly coiled, highly incrusted, unbranched, septated. Ascospores smooth, ends pointed, boat-shaped, measuring 9μ×7·5μ when flat, minimum breadth 3·5μ. Conidial colony on Czapek's agar grey green when young, darker when old. Conidiophores short, pointed, swollen in the middle, bearing a long chain of conidia at the tip. Conidia round or slightly lemon shaped when mature, roughened, usually 2-2·5μ.

Experimental

Four media were selected as mentioned below.

1. Potato slant.
2. Czapek-Dox agar with cane sugar and K_2HPO_4.
3. Filter Paper partly immersed in an inorganic salt solution of the composition

$NaNO_3$	0·5 gm.
K_2HPO_4	1·0 gm.
KCl	0·5 gm.
$MgSO_4 7H_2O$	0·5 gm.
$FeSO_4 7H_2O$	0·01 gm.
Distilled water	1000 c.c.

4. Cellulose agar, prepared by making a 1 per cent suspension of precipitated cellulose (from filter paper) in Czapek-Dox agar as in No. 2 but without sugar.

Several generations were successively subcultured on each of the media in order to follow any tendency towards reactivation or degeneration as the case might be and the incubation of any one generation was continued until it was evident that no further growth took place.

Incubation was made at room temperature, the whole test covering a period of one year. It was realized that temperature might have a considerable influence on the form of sporulation but

more or less consistent results were obtained thus enabling certain broad generalizations to be put forward. The results are given in Table I.

TABLE I

Sporulation on different media

Medium	Lab. No. 58 *Ch. chartarum* Berk., degenerate strain	Lab. No. 75 *Ch. chartarum* Berk., fresh strain	Lab. No. 79 *Ch. globosum* Kunze, fresh strain
Potato slant	Only conidia (8 generations)	Mainly mycelial; growth of perithecia stunted and spasmodic (9 generations)	Mainly mycelial; growth of perithecia stunted and spasmodic (8 generations)
Czapek's agar	Largely conidial; develops stunted hairless perithecia on continued subculture (7 generations)	Norma perithecia to start with; conidia also appear on continued subculture (7 generations)	Exclusively and profusely grey-green conidial colony (8 generations)
Filter paper medium	Conidia and stunted perithecia to start with, gradually giving place to big hairless perithecia only on continued subculture (6 generations)	Exclusive growth of normal perithecia (8 generations)	Exclusive growth of normal perithecia (7 generations)
Cellulose agar	Largely conidial with very few stunted perithecia to start with; on continued subculture perithecia become fuller with rudimentary hairs which sometimes show signs of reticulation (6 generations)	Exclusively normal perithecia to start with; conidia also appear on continued subculture (8 generations)	Exclusive growth of normal perithecia (8 generations)

It was also observed that inoculation with only conidia or ascospores had no effect on the preponderance of these two forms of sporulation on the subsequent culture.

Pure culture experiments designed to estimate the relative cellulose decomposing capacities of these species were carried out by inoculating after sterilization, weighed pieces of filter paper just immersed in an inorganic salt solution contained in small conical flasks. After incubation at 30°C. for 30 days, the residue was filtered on a weighed sintered glass crucible, washed, dried, conditioned and the crucible weighed. The results are given in Table II.

TABLE II

Relative cellulose—decomposing capacity

Laboratory No.	Per cent loss in cellulose
58	17
75	54
79	46

Discussion

From Table I it appears that for *Ch. globosum* the best medium for conidial growth was Czapek's agar ; for growth of normal perithecia both the filter paper medium and cellulose agar were equally good. It has not been possible to get simultaneous development of conidia and perithecia in any of the four media through eight generations.

The cultural behaviour of *Ch. chartarum* appears to be rather more complicated. Filter paper medium will give full perithecia, while continued subculture on cellulose agar will give conidia in addition. Continued subculture on either Czapek's agar or potato tends to increase mycelial and conidial growth at the expense of sexual spores. Transfer and repeated subculture on some cellulosic medium of strains ' degenerated ' by successive germination on these media will show a gradually growing tendency to perithecia formation, but restoration of fully developed perithecia, if possible, is slow. During any such process of restoration the same tendency of cellulose agar to support both conidia and perithecia, and of filter paper to support perithecia only is also observed.

It appears therefore, that these two species of *Chaetomium* can be preserved in what is known as the perfect state on either a strip of filter paper partly immersed in Czapek's solution without sugar, or cellulose agar containing 1 per cent regenerated cellulose. The former has the advantage of being easier and quicker to make up, while the latter has the advantages of a solid medium and in the case of *Ch. chartarum*, of producing conidia simultaneously with sexual spores. It is also seen that Czapek's agar and potato (and therefore, probably cane sugar and starch) encourage the formation of the vegetative or imperfect stages.

It is to be remembered that these conclusions are not in any sense absolute ; different results might be obtained at different temperatures and from a larger number of generations.

The figures in Table II are of interest because they establish quite clearly that the decomposition of cellulose and the production of perithecia appear to be closely related, which, in its turn, emphasizes the extreme importance of selecting the proper medium for storage purposes—especially, because the use of a pure culture of a *Chaetomium* species (e.g. *Ch. globosum*) is being increasingly advocated for testing the microbiological decay of textiles. [A.S.T.M. standards. 1942 ; Greathouse, Klemme and Barker, 1942 ; Thom, Humfeld and Holman, 1934].

Also, apart from many obvious objections against this method being accepted as a standard, it may be mentioned that at least in the special case of jute, *Ch. globosum* plays little or no part in its deterioration. During the course of several years it has never been found growing on jute nor has it hitherto been isolated from artificially rotted jute fibres or mildewed jute goods of which numerous samples have been examined. The contrary however, is found to be the case with *Ch. chartarum* which has never failed to make an appearance every time jute fibres or materials have been incubated over water. If *Ch. globosum* is native on cotton, *Ch. chartarum* appears to be its counterpart on jute and under the conditions of the particular test described it also appears to dissolve more cellulose quantitatively than *Ch. globosum*.

Summary

Chaetomium chartarum has been found to be native on jute fibre and also a strong jute-fermenting fungus. Along with the well-known cotton destroying species *Chaetomium globosum*, this species has a distinct preference for cellulose as its source of carbon and would otherwise degenerate into the imperfect stage from which it is difficult to revive. It is also found that dissolution of cellulose is directly dependent on production of perithecia in the case of *Ch. chartarum*. Two cellulose media giving vigorous perithecial growth have been found satisfactory for continued growth and storage of these two species.

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PRELIMINARY STUDIES OF THE NUTRITIONAL DISEASES OF PLANTS AND THEIR SPECTROSCOPIC DIAGNOSIS

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(With Plates XIII-XVI and one text-figure)

The intensive study of crop nutrition has brought to light numerable deficiency diseases and a new science is being built up on the nutritional diseases of crops. Symptomatic diagnosis of deficiency diseases is not easy and even when done touches only the fringe of the problem, as the symptoms are the result of the disease and not the cause. The same symptoms could, therefore, be produced by a variety of unrelated causes, e.g. an excess of one element can cause, by its particular nature, an apparent deficiency of another although no such deficiency actually exists in the soil. In other circumstances the same agent may cause a variety of symptoms depending upon its intensity. The deficiency of minor elements in Indian soils, both real and induced, forms a fruitful subject for investigation and its importance has been pointed out by Kharegat [1943].

The methods of determining mineral deficiencies in crops have been reviewed by Wallace [1943]. They are as yet not fully developed and no one method can be relied upon to give authentic data. It is, therefore, necessary to supplement symptomatic diagnosis by other corroborative analytical data. The pot culture experiments, including the addition or withholding of some mineral nutrients, have been found to be time-consuming and even sometimes misleading. The purely chemical analysis of plants and soils, although less time-consuming, would not cover the possibility of an unsuspected element causing the trouble. This has lead to the development of spectro-chemical methods which while eleminating this defect have the advantage of speed. The preliminary studies presented in this paper have been undertaken for employing the spectro-chemical methods to explain some of the peculiarities met with in the crops chiefly at the Institute farm and to supplement these findings where necessary with pot culture experiments.

Methods of spectroscopic analysis

The arc spectra on an E_2 (Adam Hilger's) spectrograph were obtained as follows: A one-gram sample of the soil after the usual sampling procedure was treated with 3 c.c. of concentrated nitric acid of tested purity in a platinum dish and evaporated on a water bath to a consistency of a thick paste. A representative sample from this was put on H. S. copper electrodes and the spectra of the samples that were to be compared, containing the characteristic lines of the different elements, were taken in juxta-position by means of the Hartman's diaphragm. By controlling the distance between the electrodes, their diameter, the current and voltage and the time of exposure on the photographic plate, the visual intensity of the lines in the spectra could be made to correspond with the concentration of the elements in the samples. Therefore, there was no need for the quantitative measurements of the line intensity in terms of an internal standard for the purpose of this diagnosis. The plant materials were also sampled in the usual way, ashed and then treated as the soil sample above. In cases where quantitative results were necessary, these were obtained after microphotometry and comparison of the unknown was effected with suitable known standards by the method of the internal standard of Gerlack and Sweitzer [1938].

The photographic plate gave more information than could be reproduced in the prints. However, many of the salient features have been brought out in the prints presented in this paper. Plates XIII and XV show some enlarged prints which give an idea as to the clear way the plates look under an eye-piece. The characteristic lines for boron at 2497·73 and 2496·78 A° are very close and are shown as faint lines near about 40·3 on the reference scale at the bottom of which is marked B. The strong magnesium line 2795·54 A° is shown at about 36·0 on the reference scale with the letter Mg. marked at the bottom. At another place also (26·2 on the scale) there are fainter magnesium lines at 3832·31 and 3838·29 A°. These are more indicative when the first and strong magnesium line is too deep to give details of small variations. Immediately to the right of the above mentioned deep magnesium line and very close to it near the scale reading of 36·0, there is a faint manganese line at 2798·27 A° at the bottom of which is marked Mn. Sometimes another but fainter manganese line is also marked at 30·1 much to the left of this line, being the second one to the left of a strong copper line. A faint zinc line is sometimes marked at 30·1 and another faint one at 21·4 between the last two of the deep triplet lines of copper. At the bottom of these are marked the letter Zn. The iron lines between 28·2 and 28·4 on the reference scale refer to those at 3570·10 and 3581·20 A° and carry the letter Fe pointing to them. The two strong calcium lines at 25·3 and 25·6 carry the letter Ca, while the finer lines at 22·5 and to its left are also marked Ca but lie on extreme right of the first set. The potassium lines 3446·72 and 3447·70 between the two deep copper lines at 24·8 and 25·0 on the reference scale are very close and carry the letter K at the bottom. From a comparison of the intensities of these lines in the healthy and diseased portions some of the plant diseases were studied and are detailed below crop-wise.

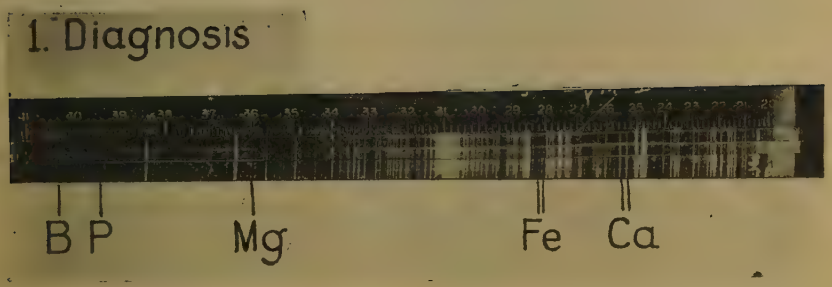
Tobacco

In the tobacco fields, in 1943 at the Imperial Agricultural Research Institute, New Delhi, there were many plants with the younger leaves composing the bud exhibiting a lighter green colour compared to their tips. These had a drawn out appearance, while some of them had a one-sided distortion or twisting. These symptoms corresponded with the boron deficiency symptoms of tobacco described by McMurtray [1938].

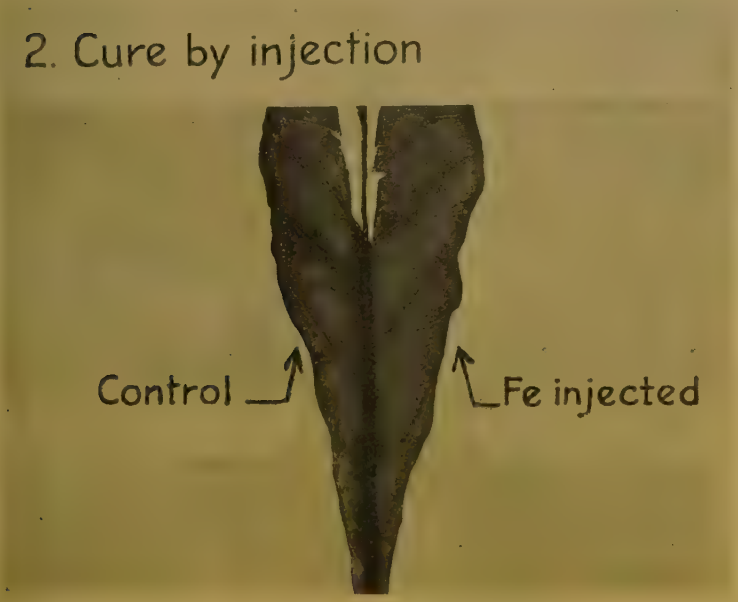
However, an actual boron deficiency in the soil could not be expected as the Delhi soil contained 35 p.p.m. of boron in it. It was, therefore, thought necessary to confirm this symptomatic diagnosis by analysis and also by simulating the conditions of this induced boron deficiency by growing tobacco in pots under conditions of varied nutrient balance. For this purpose heavy doses of N, P_2O_5, K_2O in 100·50 and 285 lb. per acre respectively and their various combinations, each with and without the addition of minor elements, were added to the soil in quadruplicate pot experiments with tobacco. The minor elements added were a combination of $CuSO_4$, zinc acetate, boric acid and manganese sulphate at the rate of 2·3 lb. per acre. Selected seedlings of adcock obtained by kind courtesy of the Imperial Economic Botanist were transplanted early in November. By January definite deficiency symptoms were produced in some of those plants.

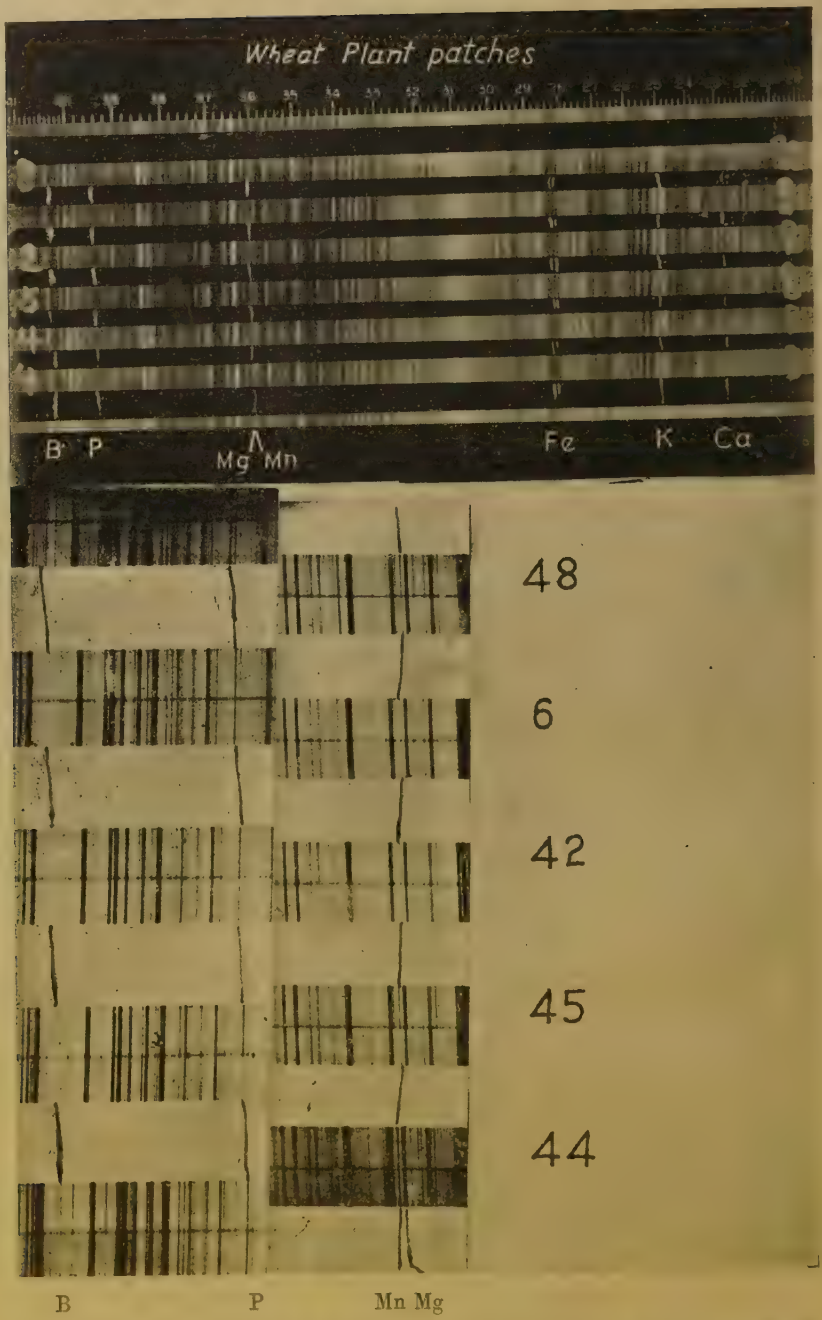
The spectra of the leaf (3A) showing the above-mentioned type of symptoms (suspected to be boron deficiency) compared to that of a healthy leaf (3) of the same physiological age (3rd leaf from the top) are shown on Plate XIII, where the intensity of the lines is proportional to the concentration in the sample of the element whose chemical symbol has been marked below that line. They are found to show a boron deficiency. These leaves had 38·7 and 65·7 p.p.m. of boron on dry basis. A leaf tip injection of 0·005 per cent boric acid was given for 24 hours to a leaf and one of distilled water to another leaf to serve as control. The boric acid injection restored the colour of the leaf compared to the control, which still retained the previous symptoms. The boron deficiency was thus confirmed.

These symptoms appeared in all the pots treated with K and to a less extent with K N suggesting that it was an excess of K which had caused this boron deficiency. This can be explained on the basis of an unfavourable Ca/K resulting from this excess of potassium as a close association between Ca and B in the plant has been reported by Warrington [1934]. This is supported by the line intensities of the various elements in 3 and 3A on Plate XIII. The spectra of the chlorotic leaf containing less boron also shows less Ca and slightly more of K, Mg., Fe., Mn. and P compared to the



Note Fe deficiency in 1A and B deficiency in 3A compared to 3 which is healthy. Below is shown the beneficial effect of Fe injection on one half of 1A leaving the other half as control showing chlorotic and patchy appearance between the darker veins.





Note the deficiency of Mn, B & Ca in the lower one (belonging to the unhealthy leaves) compared to the top one of each pair of spectra. The differences correspond with the extent of the disease. Below are shown enlargements of portions of the above on the negative to show them more clearly.

healthy leaf. Table I gives these results quantitatively in terms of the logarithm of galvanometer deflection which is proportional to the concentration of the element in the sample and which bear this fact.

TABLE I

Analysis of tobacco leaves (values in terms of log. galvanometer deflections)

Description of sample	Mg value	Ca value	K value	Fe value	Mn value	Percentage Mn on dry basis in p.p.m.	Percentage B on dry basis in p.p.m.
1—Fe injected and cured half of the leaf minus midrib	$\bar{1}$·818	$\bar{1}$·895	$\bar{1}$·539	$\bar{1}$·353	$\bar{2}$·957	4·35	..
1A-Diseased half of the leaf minus midrib	$\bar{1}$·947	$\bar{1}$·871	$\bar{1}$·652	$\bar{1}$·229	$\bar{1}$·484	1·3	..
3—Healthy leaf . . .	$\bar{1}$·826	$\bar{1}$·953	$\bar{1}$·993	$\bar{1}$·806	$\bar{1}$·041	..	65·7
3A—Leaf showing symptoms of boron deficiency	$\bar{1}$·911	$\bar{1}$·945	$\bar{1}$·996	$\bar{1}$·880	$\bar{1}$·521	..	38·7

Another type of chlorosis was found affecting the young leaves in some of the other pots. The leaves presented a clear pattern of greener veins on a chlorotic or lighter green back ground corresponding to McMurtrey's description of iron deficiency. The spectra of the chlorotic portion 1A along with that of the healthy leaf 3 is given on Plate XIII which shows an iron deficiency. A Roach's [1939] leaf tip injection of 0·05 per cent ferric sulphate was given for 24 hours to one half of the leaf, leaving the other half on the other side of the midrib as the strictest possible control which received only distilled water injection. This made the injected portion recover its colour in the chlorotic patches between the veins, while the control remained chlorotic as before. The photo of these two portions of the leaf with their spectra are shown on Plate XIII. The analytical data in terms of the log. of galvanometer deflection which is proportional to the concentration of the elements are given in Table I.

From the differences in the composition of 1A and 3 and 1 and 1A, it is seen conspicuously that the iron deficiency is accompanied by a manganese excess. This excess seems to be the cause of the disease as the iron injection which caused the cure lowered the Mn content while a manganese injection to a chlorotic leaf only aggravated its condition.

These symptoms are the same as those reported by Jacobson and Swanbuck [1929] for Mn toxicity. Bartner [1935] cured the disease by the application of phosphatic manures to the soil, McCool [1913] by K and Johnson [1924] by Fe. This literature only indicates how misleading the plant responses to manures are sometimes in respect of the deficiency diagnosis. It may be that those manures had only secondary reactions which actually corrected the excesses, which in turn were responsible for a deficiency. Thus it is possible that the same cause namely Mn excess might have induced one or more deficiencies according to the extent of this excess and the specificity of the crop. Here again the limitations of the symptomatic diagnosis are brought to light as it could show only the iron deficiency but not the Mn excess which was the cause of this deficiency. Johnson [1924] working in Hawaii associated the Fe deficiency with a Mn excess and suggested a theory to account for the unavailability of iron between pH 4·4 and 7·0 in the presence of an excess of MnO_2 in the soil. In order to see if the same is the case under study, the *p*H of the soils in relation to this chlorisis is given in Table II as determined electrometrically by the antimony electrode.

TABLE II

Soil pH in relation to manganese induced iron deficiency

Pot No.	Treatment	*p*H of the soil by antimony electrode	Occurrence of the disease
101	K+P	7·98	—
103	K+P	8·02	—
102	K+P+m	7·46	—
104	K+P+m	7·63	+
105	N+P+K	7·6	+
107	N+P+K	7·79	+(Slightly)
106	N+P+K+m	7·29	—
108	N+P+K+m	7·36	—
109	N+P+K	7·98	—
111	N+P+K	7·67	+
110	N+P+K+m	7·71	+
112	N+P+K+m	7·36	—

Although definite *pH* limits from 7·5 to 7·8 are suggested for this disease from Table II, they are much higher than the limits found by Johnson [1924] and therefore require a different explanation. From this Table, it is found that as a result of the iron injection, almost all the positive ions excepting Ca are lowered by the entry of iron which seems to suggest a simple ionic mass antagonism. On this basis the Fe deficiency seems to have been caused by the excess by simple ionic exchanges.

WHEAT

In some of the manurial experimental plots of the Institute, good and bad patches of considerable magnitude were observed. Fig. 1 obtained by kind courtesy of Mr R. D. Bose shows the nature of the stand of the crop in the different plots. This disease affected *jowar* and wheat and showed a consistency in the location of the patches indicating a relation to the soil at those places. The symptoms of the disease were very stunted growth and chlorotic spots or streaks which ranged in colour from white, whitish yellow to yellowish green. Sometimes there were lesions which in extreme case coalesced and the leaf was bent down at those places. The earheads, when they emerged, were found to be stuck up to the stems at the top. Table III gives the values of fresh weights of 20 flag leaves of wheat grown with different kinds and doses of nitrogenous manures from some of the patches, their ash, loss on ignition and nitrogen content, which shows that the diseased plants absorbed more mineral matter than they could convert into organic forms or probably that their carbohydrate and protein metabolism had been interfered with.

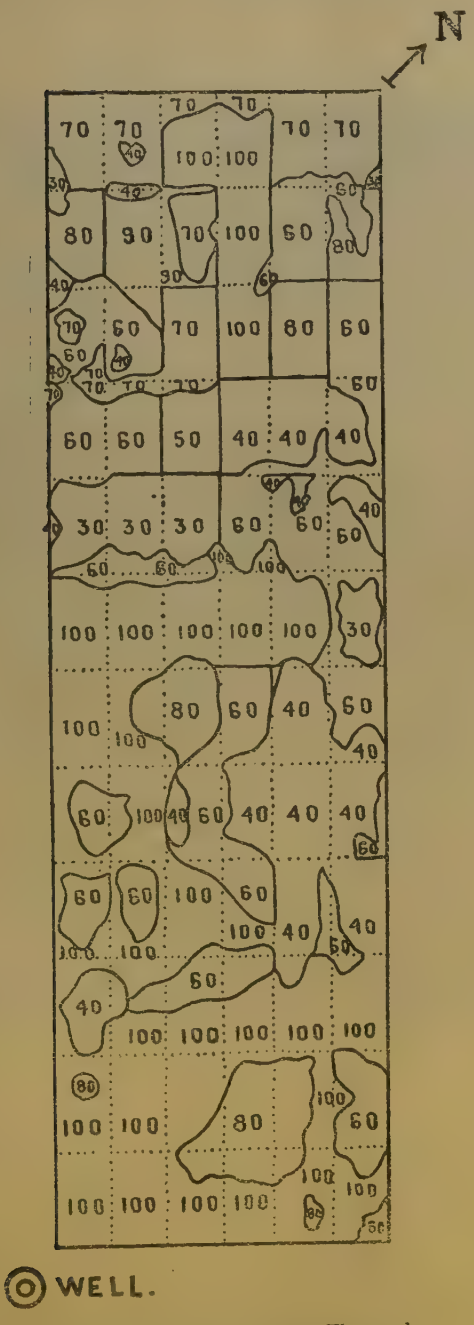


FIG. 1. Patchy appearance of the plots. The numbers indicate the nature of crop stand as percentage of normal stand as on 6-1-1944.

TABLE III

Wheat plots 1943-1944

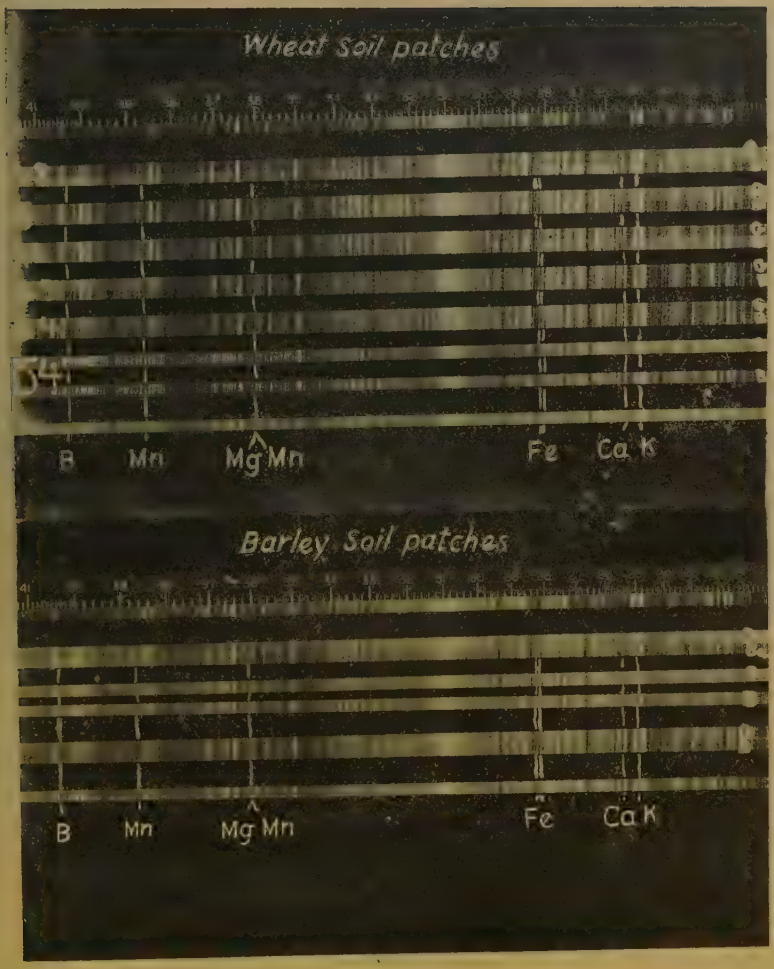
Soil Plot No.	Nature of the patch	Fresh wt. in gm. of 20 flag leaves	Loss on ignition (percentage on dry basis)	Percentage ash on dry basis	Percentage of N on dry basis
6	Good	8·25	85·7	14·3	..
	Bad	3·2	84·0	16·0	..
42	Good	6·65	87·2	12·8	3·06
	Bad	3·25	84·0	16·0	2·70
45	Good	7·3	90·9	9·10	3·72
	Bad	1·8	86·2	13·8	3·22
44	Good	5·7	90·0	10·0	3·99
	Bad	3·8	86·1	13·9	3·59
54	Good	6·2	87·4	12·6	3·00
	Bad	3·65	85·7	14·3	2·94

These symptoms do not correspond with any of the recorded deficiency symptoms although they have some features of the Mn deficiency. Such a difficulty with the symptomatic diagnosis has been recognized by Wallace [1943]. So composite samples of flag leaves were taken from both the good and bad patches and the foliar diagnosis was made spectrochemically. Plate XIV contains the spectra of these samples. The intensities and therefore the percentages of Mn and B of the lines were consistently lower for the samples from the bad patches while the relation for P, Mg and Fe was irregular. Only Ca tended to be low and K to be higher in the diseased plants. That both Mn and B showed a deficiency has the parallel in the French experience quoted by Dennis [1937] that a soil showed a B deficiency for beet and a Mn deficiency for oats. In the case of these samples the Mn lines seem to follow the order of differences between the good and bad patches. In the plots showing smallest difference in the Mn line (i.e. Plot No. 48) there was also not much difference in the plant height in those patches. This diagnosis reveals the similarity of this with the grey speck disease caused by a deficiency of manganese studied by Hudig [1911] and Samuel and Piper [1928]. This is supported by the *p*H values of these soils (Table IV) which are all alkaline, the bad patches generally showing slightly higher *p*H. The cause of this disease, its mechanism and cure are under investigation.

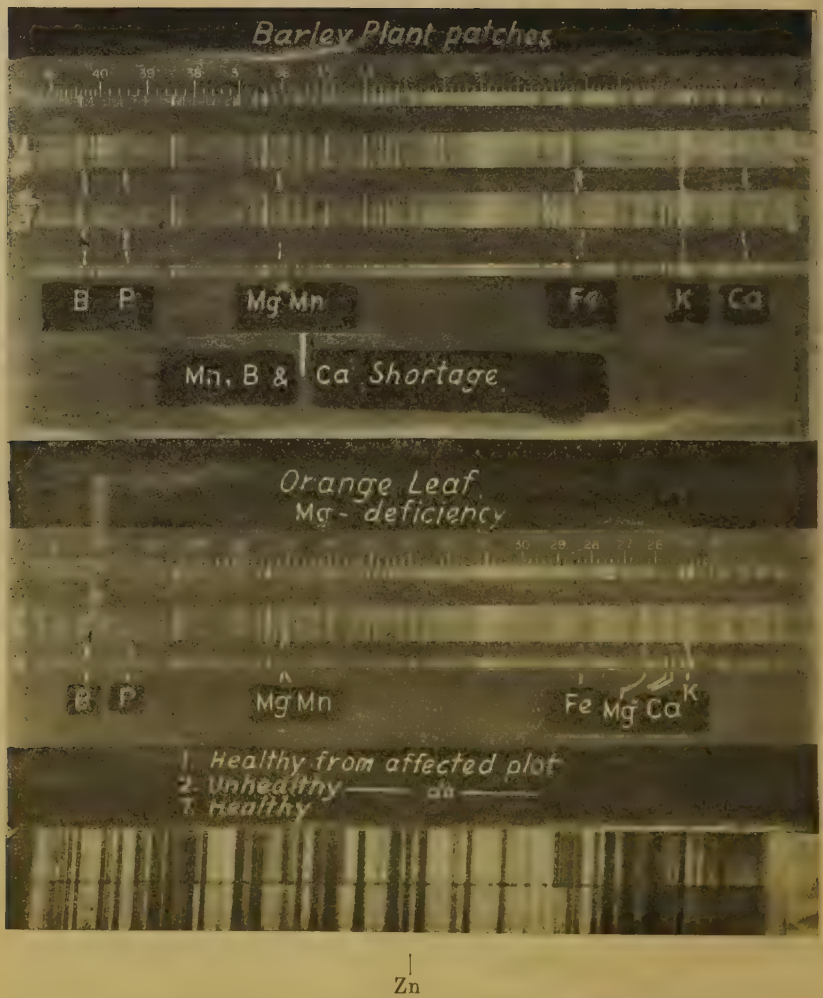
TABLE IV

*p*H *of the good and bad patches of wheat soils by the antimony electrode and the clay content by Puri's method*

Plot No.	Nature of patch	*p*H value	Percentage of the clay
6	Good	8·02	6·99
	Bad	8·09	7·09
42	Good	8·0	5·79
	Bad	8·01	6·33
45	Good	8·09	6·73
	Bad	8·18	6·67
44	Good	7·79	6·73
	Bad	8·09	6·90
54	Good	8·21	..
	Bad	8·17	..
48	Good	8·09	..
	Bad	8·14	



In these spectra G refers to the good & B to the bad soil samples. The minor element deficiency shown by the plants are however not shown by their soils but there is an indication of a K excess in the bad samples which is responsible for the minor element deficiencies in the plant.



G & B on the spectra refer to good and bad samples. Note the similarity of the disorders in the barley plant patches with those in the wheat plant patches on plate 2.

In the next set, the Mg deficiency in the orange leaf is accompanied by an Fe excess.

The enlarged spectral pair on white background shows the Zn deficiency in the soil carrying the unhealthy betel nut trees compared to its healthy counterpart.

The spectra of the corresponding soils are given in Plate XV which show slightly more of K and probably Ca in the bad patches. The clay contents (Table IV) are also tending to be higher along with the *p*H, which may indicate the direction of the water movements which seem to have a bearing on the cause of this disturbance in the soil. But Mn and B in the soil (Plate XV) do not show the difference they have shown in the plants (Plate XIV). Therefore it is not the total manganese content of the soil but only the available portion which is effective; this was also the case in the grey speck disease studied by Gerretsen [1937] that is responsible for this disease. The fact that the soil from the bad patches is a bit more alkaline containing more of K with a similar increase in the K content of the corresponding plants points to mechanism of the unavailability of Mn as also to the possibility of curing the disease by proper cultural practices alone. Some of the analytical data on the boron and manganese content of these plants and soils are given in Table V.

TABLE V

Analysis of wheat patches

Plot No.	Nature of the patch	Mn in p.p.m. in plant ash	B in p.p.m. in plant ash	Mn in p.p.m. in the soil	B in p.p.m. in the soil
6	Good	42·7	32·7	4·1	17·2
	Bad	34·7	20·0	7·4	30·9
42	Good	53·7	15·31	12·0	24·6
	Bad	16·4	13·8	43·2	14·3
45	Good	74·1	51·3	70·0	4·79
	Bad	27·5	10·0	164·8	13·5
44	Good	171·8	59·6	10·0	7·08
	Bad	80·4	19·9	6·9	100·0
54	Good	102·3	36·3	41·7	3·89
	Bad	25·7	35·5	26·9	2·14
48	Good	35·1	112·00	..	42·7
	Bad	37·1	16·8	38·0	8·9

BARLEY

In the case of this crop the symptoms and nature of the disease were more or less similar to those described under wheat except that the spots were more frequently purplish brown which followed the higher iron content of the diseased leaves as shown in the spectra on Plate XVI. In this crop also the plants from the bad patches showed a deficiency in Mn, B and slightly in Ca and their soils (Plate XV) showed an increase in K and Fe bringing out the complete similarity of the disorder in both the crops. The results are given in Table VI.

TABLE VI

Analysis of barley patches

Plot No.	Nature of patch	Mn in p.p.m. in plant ash	B in p.p.m. in plant ash
1	Good (highly differentiated)	70·8	43·7
	Bad ,,	38·9	23·7
2	Good (slightly differentiated)	68·0	27·5
	Bad ,,	70·0	15·3
3	Good (moderately differentiated)	57·6	21·6
	Bad ,,	38·9	20·6

Citrus (orange)

The Director of Agriculture, Assam, and the Imperial Mycologist reported a common 'yellowing disease' of citrus in that province which manifested itself sometimes as a mottling of yellow on the green leaf, sometimes as a simple chlorosis and finally yellow colouration of the entire leaf. This disease was expected to be a zinc deficiency from the symptoms but experiments for its cure with zinc were not successful. The samples were sent to us through the Imperial Mycologist. On Plate XVI are the spectra of the samples of leaves. Nos. 7 and 8 belong to healthy trees from a healthy and unaffected plantation. Nos. 1 and 2 are from a plantation which was susceptible to this disease, the former taken from the healthy and the latter from the unhealthy trees of that area. An excess of Fe and a deficiency of Mg could be found in spectra of the plant ash. The examination of their soils spectroscopically showed a similar iron excess in the affected area of the soil. This appears, therefore, to be an iron induced magnesium deficiency and points to the desirability of an application of Mg which is capable of suppressing the iron intake of the plant by virtue of its ionic reactions. This is in conformity with the American experience of the association of Mg with Zn deficiency [Kharegat 1947]. The other effects of this disorder are a low nitrogen absorption in the affected plant as shown by their nitrogen contents.

Betelnut

Many plantations in the Bombay Presidency have a disease locally called 'band' which was causing great damage to the betelnut trees. There was an untimely fall of the leaves which assumed a chlorotic appearance with sometimes the setting of 'crowns' or 'rosettes' and the diseased portions did not bear fruit. The samples from some of those gardens were sent to us for analysis by Mr N. V. Joshi. The spectra of the unhealthy soils showed a zinc deficiency while the corresponding leaf showed a manganese excess. One enlarged spectrum of a pair of healthy and diseased soils is shown at the bottom of Plate XVI. Hence a zinc deficiency, probably manganese induced, could be suggested. Subsequently zinc was applied by Mr Joshi and was found to have a stimulating or a corrective influence, while the addition of manganese only aggravated the trouble.

Discussion

In all the cases studied here, there was an invariable association of these deficiencies with an excess of another element, which appears to be the more common way in which these elements are rendered deficient in India. Although there may not be any actual deficiencies in the soils, these were presumably caused by an upset of the nutrient balance in the soil. This is shown by the ionic relations between iron and manganese, where the excess of the latter caused the deficiency in the former while an iron injection into the diseased plant reversed this process in tobacco. A similar mechanism has been suggested by Lundegardh [1934] for the cause of the grey speck diseases in oats and is probably the more common way these deficiencies are established in soils. A suitable remedy could be devised only by knowing the deficiency as well as its cause. As for example zinc deficiency symptoms could not be corrected unless a causative copper deficiency was first corrected [Camp, Chapman, Bahrt and Parker, 1941]. Similar is the case when the deficiency is caused by the excess of another element. The spectrochemical analysis of soils and plants give an insight both into the deficiency and the causative excess if any, while the symptomatic diagnosis at best gives only one. The symptomatic diagnosis is very intricate because different symptoms develop for the same deficiency depending on the nature and extent of the causative excess [Bahrt 1941]; and different deficiencies may also be caused by one and the same cause, e.g. excess of lime, etc. The manurial trials by themselves are only empirical and their success may only be indirect and temporary as they give no clue to the understanding of the cause of the troubles. This is because any of the several manures may affect a temporary remedy by their side reaction with the element in excess, and therefore may appear in the first instance to have corrected the deficiency. In all these cases the analytical method has to be used but this suffers from the drawback that it cannot be handled by the lay farmer.

Summary

1. Some minor element deficiency diseases of tobacco, wheat, barley, citrus and betelnut occurring in India are recorded.

2. In all these cases, the deficiencies were found to be associated with an excess of some other element. Depending on the extent of this excess, deficiencies of some or more elements occurred giving a wide range of deficiency symptoms. This provides the reason for the failure to affect a cure by the consideration of symptoms alone.

3. It was found that the spectrochemical analysis of the affected soils and plants in comparison with their healthy counterparts provided an insight into both the element in excess and the secondary deficiencies.

4. The spectrochemical diagnosis could be successfully used for correcting these diseases.

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PLANT QUARANTINE NOTIFICATIONS

Notice No. 4 of 1945

THE following quarantine regulations have been received in the Imperial Council of Agricultural Research. Those interested are advised to apply to the Secretary, Imperial Council of Agricultural Research, New Delhi.

1. Service and Regulatory Announcements—October-December 1944
2. Service and Regulatory Announcements—October-December 1942
3. Service and Regulatory Announcements—Januray-March 1945

Regarding Foreign Quarantine from the United States Department of Agriculture.

Notification No. F. 15-1/45-A, dated the 12th November 1945, of the Government of India in the Department of Agriculture.

In exercise of the powers conferred by sub-section (1) of Section 3 of the Destructive Insects and Pests Act 1914 (II of 1914), the Central Government is pleased to direct that the following amendment shall be made in the notification of the Government of India in the Department of Agriculture No. F. 15-1/45-A, dated the 25th September 1945, relating to the import of apples, pears and quinces from Afghanistan namely :

In the said notification after the word ' prohibit ' the following shall be inserted, namely : ' with effect from the 1st January 1946 '.

Notification No. F. 15-1/45-A, dated the 12th November 1945, of the Government of India in the Department of Agriculture.

In exercise of the powers conferred by Section 4A of the Destructive Insects and Pests Act, 1914 (II of 1914), the Central Government is pleased to direct that the following amendment shall be made in the notification of the Government of India in the Department of Agriculture No. F. 15-1/45-A, dated the 25th September 1945, relating to the export of apples, pears and quinces from British Baluchistan namely :

In the said notification after the word ' prohibit ' the following shall be inserted, namely : ' with effect from the 1st January 1946 '.

VGIPC—M—III-1-5—15-11-46—600.

Instructions to Authors

Articles intended for the *Indian Journal of Veterinary Science and Animal Husbandry* should be accompanied by short popular abstracts of about 330 words each.

In the case of botanical and zoological names the International Rules of Botanical Nomenclature and the International Rules of Zoological Nomenclature should be followed.

References to literature, arranged alphabetically according to authors' names, should be placed at the end of the article, the various references to each author being arranged chronologically. Each reference should contain the year of publication, title of the article, the abbreviated title of the publication, volume and pages. In the text, the reference should be indicated by the author's name, followed by the year of publication enclosed in brackets; when the author's name occurs in the text, the year of publication only need be given in brackets. If reference is made to several articles published by one author in a single year, these should be numbered in sequence and the number quoted after year both in the text and in the collected references.

If a paper has not been seen in original it is safe to state 'Original not seen'.

Sources of information should be specifically acknowledged.

As the *format* of the journals has been standardised, the size adopted being crown quarto (about $7\frac{1}{8}$ in. $\times 9\frac{5}{8}$ in. cut), no text figure, when printed, should exceed $4\frac{1}{2}$ in. $\times$ 5 in. Figures for plates should be so planned as to fill a crown quarto plate, the maximum space available for figures being $5\frac{3}{4}$ in. $\times$ 8 in. exclusive of that for letterpress printing.

Copies of detailed instructions can be had from the Secretary, Imperial Council of Agricultural Research, New Delhi.